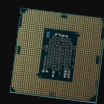


Intel Skylake: First test of the Core i7-6700K and Core i5-6600K



CUSTOM PC

THE BEST-SELLING MAG FOR PC HARDWARE, OVERCLOCKING, GAMING & MODDING / ISSUE 145

Dream PCs

The fastest and flashiest
PCs money can buy

CUSTOM
PAINT JOBS

GORGEOUS
WATER COOLING

EXTREME
OVERCLOCKS

MULTIPLE
GRAPHICS CARDS

PLUS

INSIDE THE
SCUMM ENGINE
THE SECRET OF
MONKEY ISLAND

HOW TO
GIVE YOUR PC A
POLISHED METAL FINISH



OCTOBER 2015 / £5.99

Iiyama's ULTRA SLIM **MONITOR SERIES**, PERFECT FOR MULTI MONITOR ARRANGEMENTS



xx90 ultra slim monitor line with clear and vivid image,
perfect for multi monitor arrangements.

Available in 22", 23", 24", 25" and 27" with and without height
adjustable stand.



i iyama

www.iiyama.com

Welcome

Custom PC Issue 145

Editorial EDITOR

Ben Hardwidge
editor@custompcmag.org.uk

LABS

Antony Leather

MODDING EDITOR

Antony Leather

GAMES EDITOR

Rick Lane

ART EDITOR

Bill Bagnall
www.billbagnalldesign.com

PRODUCTION EDITOR

Julie Birrell

CONTRIBUTORS

Gareth Halfacree, James Gorbald,
Mike Jennings, Orestis Bastounis,
Paul Goodhead, Richard Swinburne,
Sam Batten, Simon Treadaway, Tracy King

PHOTOGRAPHY

Antony Leather, Gareth Halfacree,
Henry Carter, Mike Jennings

Publishing & Marketing

GROUP PUBLISHER

Paul Rayner
paul_rayner@dennis.co.uk

LICENSING MANAGER

Carlotta Serantoni
Carlotta_Serantoni@dennis.co.uk
+44 (0)20 7907 6550

LICENSING &

SYNDICATION ASSISTANT

Nicole Adams
Nicole_Adams@dennis.co.uk
+44 (0)20 7907 6134

SYNDICATION SENIOR MANAGER

Anjum Dosaj
+44 (0)20 7907 6132

Commercial & Advertising

Paul Rayner
paul_rayner@dennis.co.uk



Dennis Publishing Limited
Tel: 020 7907 6000 fax 020 7907 6193

DIRECTOR OF ADVERTISING

Julian Lloyd Evans

MANAGING DIRECTOR

DENNIS TECHNOLOGY

John Garewal

CEO

Ian Westwood

NEWSTRADE DIRECTOR

David Barker

FINANCE DIRECTOR

Brett Reynolds

GROUP FINANCE DIRECTOR

Ian Leggett

CHIEF EXECUTIVE

James Tye

COMPANY FOUNDER

Felix Dennis

Subscriptions

You can manage your existing subscription
through www.subsinfo.co.uk – this should be
your first port of call if you have any queries
about your subscription. Email: custompc@servicehelpline.co.uk

Annual subs: UK £44.99

UK subs: 0844 844 0032

Overseas subs:

Europe £65, ROW £85

Overseas subs: +44 (0)1795 592 906

LICENSING, REPRINTS, EPRINTS

Wright's Media
0800-051-8327 (Toll Free)

Printed by BGP

Distributed by Seymour Distribution
Tel: 020 7429 4001

OVERSEAS NEWSSTAND

Geraldine Grobler
Seymour International Ltd
+44 (0)20 7429 4066



When you have finished with
this magazine please recycle it.

The paper used in this magazine is produced from sustainable
fibre, manufactured by mills with a valid chain of custody.

DON'T TRY THIS AT HOME

The information in this magazine is given in good faith. Dennis Publishing Limited cannot accept any
responsibility for loss, disruption or damage to your data or your computer that may occur as a result
of following or attempting to follow advice given in the magazine. If things do go wrong, take a break.

Custom PC is produced by Mr Freelance Limited, and published monthly by Dennis Publishing Ltd,
30 Cleveland Street, London W1T 4JD, a company registered in England number 1138891.

Entire contents © Dennis Publishing Ltd licensed by Felden.

© Copyright Dennis Publishing Limited. Custom PC is a trademark of Felix Dennis.

Contents

Welcome to Issue 145

40 Dream PCs 2015

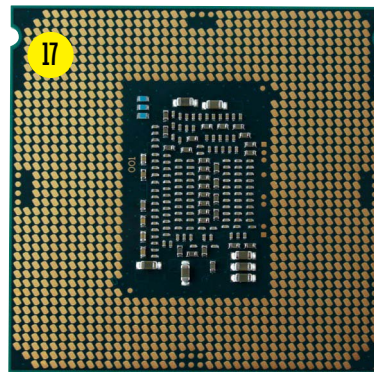
Beautiful water-cooling loops, extreme hardware, epic performance and outlandish modding are the focus of this month's 20-page Labs test. We've asked several UK's leading PC makers to build systems they consider worthy of the Dream PC title.

This year we're also have two price tiers. We start at a modest, but still lavish price limit of £6,000, with three systems from Scan, Overclockers and Chillblast. We then have the extreme machines, which hover around the £10,000 mark. There's a total of seven GTX Titan Xs and three GTX 980 Ti cards in the top tier alone, so if you're lucky enough to have the cash for an ultimate PC, or like any good enthusiast, you just want to see the amazing feats of PC building you can achieve when money is no object, this month's Dream PC Labs test will be a treat.



Highlights

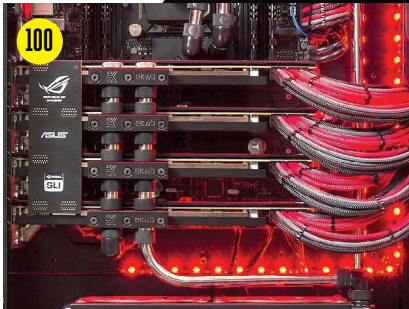
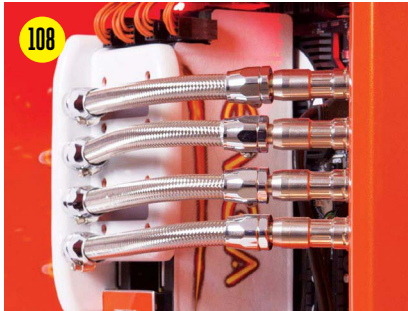
- 10** Tick-tock flip-flop
Our man in Taiwan, Richard Swinburne, analyses Intel's failure to maintain its previous two-year tick-tock CPU strategy.
- 14** Losers weepers
Are sexist harassers in gaming really just sore losers? Tracy King delves behind the headlines.
- 17** Intel Skylake
We run Intel's new K-series CPUs and an Asus motherboard through our gruelling test suite to see how they fare.
- 27** AMD Radeon R9 300-series
Asus sends us some new cards based on AMD's Radeon R9 300 series of GPUs, as well as a Fury card.



- 86** SCUMM and villainy
Rick Lane speaks to SCUMM lord Aric Wilmunder about the tech behind The Secret of Monkey Island and Day of the Tentacle.
- 90** Gaming archaeology
Where do games go when they're cancelled, and should we preserve our gaming heritage? Sam Batten delves into the gaming museum archives.



- 94** Hobby tech
Gareth Halfacree tries his hand at 3D printing with a Velleman pen, visits Liverpool MakeFest 2015 and takes a look at the Circuitbeard Petduino.
- 102** How to give your PC a polished metal finish
Antony Leather shows you how to give your PC's metal case a dazzling sheen, taking you through the various polishing techniques.



Regulars

- 8 From the editor
- 10 Richard Swinburne
- 12 Letters
- 14 Tracy King
- 15 Incoming
- 34 How we test
- 38 Custom kit
- 62 PC system reviews
- 68 Elite
- 79 Inverse look
- 86 The engine room
- 94 Hobby tech
- 100 Customised PC
- 102 How to guides
- 107 RealBench leaderboard
- 108 Readers' drives
- 112 Folder of the month
- 113 Your folding milestones
- 114 James Gorbod

Cover guide



Reviewed this month

Hardware

CPUs

- 17 Intel Core i5-6600K
- 17 Intel Core i7-6700K

MOTHERBOARD

- 22 Asus Z170 Deluxe

MEMORY

- 24 Corsair Vengeance LLPX DDR4 2666MHz

GRAPHICS CARDS

- 27 Asus Radeon R9 380 Strix Gaming DirectCU II OC 2GB
- 27 Asus Radeon R9 390 Strix Gaming DirectCU III OC 8GB
- 27 Asus Radeon R9 390X Strix Gaming DirectCU III OC 8GB
- 27 Asus Radeon R9 Fury Strix Gaming DirectCU III 4GB

KEYBOARD

- 31 Corsair Gaming Strafe

Custom kit

- 38 Antec TrueQuiet 120 UFO
- 38 Arctic Smart Charger 8000
- 38 BG Nexus USB Plug Socket
- 39 Cardboard Smartphone Projector
- 39 Icy Box IB-112STU3-B
- 39 Warp Pipe Mug

Dream PC Labs

- 41 Chillblast Arkham Knight Dream Edition
- 44 Overclockers Infin8 Emperor
- 48 Scan 3XS Cyclone
- 52 Dino PC T. Rex
- 55 Overclockers 8Pack Supernova
- 58 Scan 3XS Barracuda

PC system reviews

- 62 CyberPower Infinity X3 SE
- 64 Eclipse Excalibur i7582n970-OC
- 66 Scan 3XS Z170 Vengeance

Games

- 80 Batman: Arkham Knight
- 82 RONIN
- 82 Feist
- 84 F12015

Hobby tech

- 94 Velleman 3D Printing Pen
- 98 Circuitbeard Petduino

Cyberpower recommends Windows.

CYBERPOWER

Create the PC of Your Dreams

One experience for everything
in your life.



To Custom Build Your Ideal Desktop or Laptop, Visit :
www.cyberpowersystem.co.uk
0844 371 2727



Infinity Xtreme

Windows 8.1

Extreme Performance Gaming Station

MSI® X99A RAIDER Mainboard
16GB HyperX Predator 2133Mhz DDR4 Memory
240GB Kingston V300 SSD
2TB 7200rpm SATA III 6.0Gb/s 64MB HDD
4GB Nvidia® GTX 970 Video Card

NZXT H440 Gaming Case

Corsair H55 Cooling System

LCD monitor is not included but optional

Intel® Core™ i7 Processor
5960X £ 2039
5930K £ 1599
5820K £ 1399

From **£1399** Inc VAT and Del



Infinity X5

Windows 8.1

A Media Dream for Photo/Video Editing
4th Generation Intel® Core™ Processor

Gigabyte® Z97-HD 3 with SATA III, USB 3
8GB Kingston HerperX Fury 1866mhz Memory
2TB 7200rpm SATA III 6.0Gb/s 64MB HDD
2GB Nvidia® GTX 960 Graphic Card
NZXT Phantom 410 Mid Tower White

Corsair H55 Cooling System

LCD monitor is not included but optional

Intel® Core™ i7 Processor
4790K 3.5Ghz £ 955
4790 3.4Ghz £ 919

Intel® Core™ i5 Processor
4690K 3.4Ghz £ 859
4690 3.4Ghz £ 845
4590 3.2Ghz £ 825

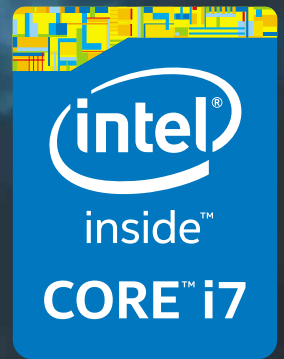
From **£825** Inc VAT and Del



Unleash The Power

- Free UK delivery*
 - All desktops come with 3 year warranty**
 - Flexible finance available and secure online payment
- *UK mainland only, see our website for detail
**See our website for detail

Explore new ways to learn and stay connected with Intel Inside®.



Infinity Xtreme Pro Windows 8.1

Extreme CPU & VGA Water Cooling Gaming Monster
Intel® Core™ Processor i7-5960X

ASUS® X99-A Mainboard
16GB HyperX Predator 2133Mhz DDR4 Memory
480GB Kingston V300 SSD
2TB SATA III 6.0Gb/s 64MB HDD
4GB Nvidia® GTX 980 Graphic Card
16X Pioneer BluRay BDR-209DBK Writer Black
CoolerMaster Staker 935 Gaming Case
Cyberpower Advance Water Cooling system Medium Size
LCD monitor is not included but optional

Intel® Core™ i7 Processor Extreme Edition
5960X 3.00Ghz 20MB £ 2545
5930K 3.50Ghz 15MB £ 2099
5820K 3.30Ghz 15MB £ 1899

From **£ 1899**
Inc VAT and Del



Infinity X3 Windows 8.1

Great Value for Money Home PC with Water Cooling

ASUS® H81M-P Mainboard
8GB Kingston HyperX Fury 1866Mhz DDR3 Memory
2TB 7200rpm SATA III 6.0Gb/s 64MB HDD
2GB NVIDIA® GTX 750 video card
CoolerMaster HAF 912 Gaming Case
Corsair H55 Cooling System
LCD monitor is not included but optional

Intel® Core™ i7 Processor
4790K 3.6Ghz £ 795
4790 3.5Ghz £ 759

Intel® Core™ i5 Processor
4690K 3.4Ghz £ 699
4690 3.4Ghz £ 685
4590 3.2Ghz £ 665

Intel® Core™ i3 Processor
4370 3.6Ghz £ 619
4350 3.5Ghz £ 619
4170 3.4Ghz £ 589

From **£ 589**
Inc VAT and Del



Infinity X7 Windows 8.1

High Performance All-Rounder
Intel® 4th Generation Core™ Processor

ASUS® Z97-P Mainboard
16GB HyperX Fury 1866Mhz DDR3 Memory
240GB Kingston V300 SSD
2TB 7200rpm SATA III
4GB Nvidia® GTX 970 Video Card
CoolerMaster Cosmos SE Full-Tower Gaming Case
Corsair H55 Cooling System
LCD monitor is not included but optional

Intel® Core™ i7 Processor
Extreme Edition
4790K 3.6Ghz £ 1265
4790 3.5Ghz £ 1229

From **£ 1229**
Inc VAT and Del



FANGBOOK EGDE S 4K Windows 8.1

Gaming Laptop with 4th Generation
Intel® Core™ i7-4720HQ Mobile Processor
Intel® HM87 Chipset
WiFi Link 802.11 A/B/G/N Wi-Fi + Bluetooth Combo
16GB DDR3 1600 SODIMM Memory
1TB 5400RPM SATA HDD
15.6" 4K UHD 3840 x 2160 Display
2GB Built-in Nvidia® GeForce® GTX 965M Video Card
Built-in FHD Webcam, 1 HDMI Port

Intel® Core™ i7 Processor
4720HQ £ 1099

From **£ 1099**
Inc VAT and Del



FANGBOOK EVO HX7-800 Windows 8.1

Gaming Laptop with 4th Generation
Intel® Core™ i7-4940MX Extreme Mobile Processor
Intel® HM87 Chipset
Intel® Dual Band Wireless- AC 7260HMW
802.11AC, Wi-Fi + BT 4.0 combo
16GB DDR3 1600 SODIMM Memory
240GB Kingston V300 MLC SSD
1TB 5400RPM SATA HDD
17.3" Full HD 1920 x 1080 Display
8GB Built-in Nvidia® GeForce® GTX 980M Video Card
Built-in 720P HD Webcam

Intel® Core™ i7 Processor
Extreme Edition
4940MX £ 2135
4910MQ £ 1689
4810MQ £ 1505
4710MQ £ 1389

From **£ 1389**
Inc VAT and Del





BEN HARDWIDGE / FROM THE EDITOR

LAST GASPS OF THE MEDIA PC

Windows 10 finally sees the discontinuation of Windows Media Center, but Ben Hardwidge asks if there's still a place for media PCs in the lounge

Windows 10 is out. Yay! It has DirectX 12. Yay! It doesn't have the horrific, jarring jumps between the Windows and Metro Start screen when you hit the Start key any more. Yay! It looks as if Windows is appropriate to use on a desktop PC again. Yay! Windows Media Center has been discontinued. Ya... wait, hang on, I still use Media Center, what's going on?

I understand why Microsoft isn't bothering with Media Center any more. It never really took off in the mainstream, and it had some weird quirks too – I particularly like the one where sometimes the sound is completely out of sync with the video and you have to restart your programme. Yet Media Center arguably had the best remote-control TV interface ever devised for the PC – text and icons are big and readable, it's fast and responsive, and you don't have to faff around with a keyboard and mouse.

Of course, there are other media systems for the PC, including XBMC, but as a general-purpose PVR for recording TV programmes, Media Center did the job really well, as long as you disabled interruptions such as automatic restarts anyway. But Microsoft's discontinuation of Media Center carries a deeper implication with it, which is that PCs in the lounge are now becoming a rarity.

I have an AMD APU PC in my lounge, mainly because it's the only device that does every media job I want. I can use Audacity to record my LPs, I can plug in a webcam and use it for Skype, I can play back my lossless audio collection with the full version of iTunes through my USB DAC, I can use any video streaming service via the Web, including iPlayer, BlinkBox, Netflix and

Amazon Prime. It can run Spotify, it can rip CDs, it can record TV, it can output surround sound via HDMI and it can even play some games.

No other media device does all of this. Sure, smart TVs are becoming more and more sophisticated, and most have features to play back content from some streaming services, as do devices such as the Chromecast, but there isn't a device that does it all, which is why I still have a PC in my lounge. It isn't perfect, of course. If I'm not using Media Center, I still have to faff around with my wireless Logitech keyboard with its built-in touchpad. It works okay, but it's still a faff. Also, the Windows 8 Metro Start screen works surprisingly well on a big TV if you're using the Netflix app.

It's not that the PC is the best tool for all these jobs, but that there isn't another device with so much flexibility, and that's a damn shame. I reckon there's a gap in the market for an all-in-one media system that does every single job with an intuitive interface, but until then I'm going to need a PC in my lounge, and it's a bit irritating to see some of the features I use being discontinued.

Is it just a few stragglers such as myself who still use a PC for media jobs, simply because there isn't anything better, or am I just a confused old man who won't let go of the past? Valve's ideas for Steam boxes in the lounge would suggest I'm not alone in wanting a PC in the lounge, but those machines are primarily designed for gaming. I'd be really interested in the thoughts of our readers about this subject. Do you still use a PC for media in the lounge? Let me know at letters@custompcmag.org.uk **GPC**

The PC isn't the best tool for these jobs, but there isn't another device with so much flexibility

Ben Hardwidge is the editor of Custom PC. He likes PCs, heavy metal, real ale and Warhammer 40,000. editor@custompcmag.org.uk [@custompcmag](https://twitter.com/custompcmag)



QUICKFIRE RAPID-i

MECHANICAL GAMING KEYBOARD



FULL LED
BACKLIGHT



NKRO



LIGHTING
MANAGEMENT



ACTIVLITE

"...a very solid keyboard, with nearly everything you could want in terms of backlighting"
- Antony Leather Bit-Tech.net

"Build quality is exceptional on this keyboard, it's easily one of the toughest in its class..."
- Peter Donnell eTeknix.com

"Primarily the big change is the removal of the numpad. This has major benefits to the footprint of the Rapid-i"
- Bryan Waters OverClock3D

"The ability to illuminate only the keys that you're playing with and having four Profiles to use means you can pretty much have this Iced Cake and eat it!"
- James Crewe pcGameware.co.uk



RICHARD SWINBURNE / VIEW FROM TAIWAN

TICK-TOCK FLIP-FLOP

Intel has failed to maintain its two-year tick-tock CPU strategy, but Richard Swinburne asks if it's our expectations that need adjusting

In its recent Q2 earnings statement, Intel confirmed troubles with its most recent 14nm manufacturing process. We've known about this situation for a while, as it was confirmed by the delay and subsequent non-event of Broadwell for desktop enthusiasts (C-suffix CPUs have all gone to system builders rather than retailers).

However, these problems have also had a knock-on effect on the forthcoming 10nm upgrade, which has been delayed a year from 2016 to the second half of 2017. In that gap, Intel will release a third 14nm architecture (where Broadwell was the first and Skylake is second).

This change in schedule effectively marks the end of the two-year, tick-tock era, although to be honest, in the face of ever-increasing technological challenges, it's remarkable that Intel sustained this strategy for so long. Having been the first to market with high-k metal gate (HKMG) at 45nm in 2007, and FinFET (or '3D transistors' as Intel branded them) at 22nm in 2012, it wasn't until 2010 and 2015 respectively that the rest of the industry caught up.

Instead of a two-year tick-tock strategy for process shrinking, Intel will shift to a two-and-a-half to three-year strategy instead. With TSMC and Samsung (and, via licensing, GlobalFoundries too) aggressively pursuing 16/14nm manufacturing this year, with aspirations to hit 10nm at a similar time around 2017, Intel is about to lose its lead.

Since we're going to be sitting on the same manufacturing process for longer, much like GPUs have been stuck on a 28nm process for the past three years, our expectations will have to change to match this new norm. Product refreshes will require more inventive architectural (such as Nvidia Maxwell) and software optimisations (such as 'low overhead' interfaces in

the vein of DirectX 12 and NVMe SSDs) to achieve the same stimulus as a process shrink.

If we think further down the road, there remain serious questions about transistors below the 7nm mark. IBM has only just recently sung about a chip it's made at 7nm (without defining the chip's type or purpose), but Intel and TSMC have yet to join in the chorus. If 10nm chips are due in 2017, expect 7nm chips closer to 2020. Retaining that two-year cadence would have required a monumental effort to avoid exhausting transistor technology – and the entire semiconductor business – in practically the same time frame.

At least a cadence of around three years extends our upgrades into the mid-2020s, and it's good news for prices too. The cost of manufacturing chips with a new transistor size usually comes down over time, but the increasing cost of developing and using each process shrink means that investment recoup takes longer each time.

TSMC has already stated that the cost per transistor at 16nm is higher due to increasingly complex chip design and manufacturing techniques – reversing a life-long trend where smaller transistors basically meant you could pack more of them into a smaller space, resulting in more dies per wafer and thus cheaper chips.

Intel claims its 14nm process still sees a cost advantage; however, as it makes and sells its own chips, its metrics are different from those of a company such as TSMC or GlobalFoundries. However, a longer time spent at 14nm and 10nm means the cost of chips at retail at least shouldn't shoot upwards. The progress of desktop CPU tech is slowing, but in the long run, we should still be able to look forward to new architectural changes, new features and cheaper prices. **GPC**

Further down the road, there are serious questions about transistors beyond 7nm

Richard has worked in tech for over a decade, as a UK journalist, on Asus' ROG team and now as an industry analyst based in Taiwan @Bindibadgi



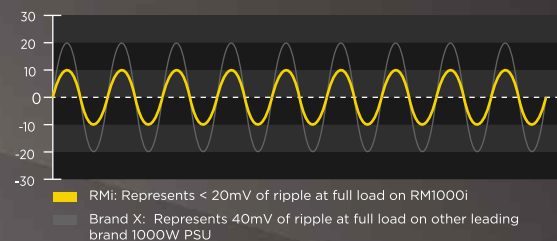
PREMIUM COMPONENTS DELIVER EXCEPTIONAL PERFORMANCE

RM1000i

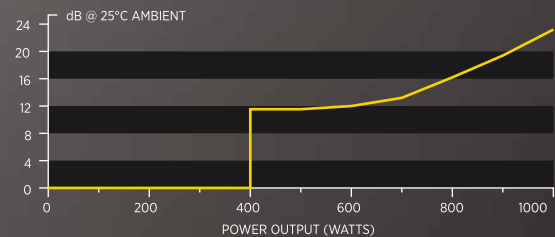
Corsair RMi Series power supplies are **80 PLUS Gold certified** and give you extremely tight voltage regulation, virtually silent operation, and a fully modular cable set.



- > **Engineered for extremely tight voltage regulation** and best-in-class ripple and noise suppression.



- > **Zero RPM Fan Mode** delivers silent operation at low and medium loads.



- > **Corsair Link Digital** makes it easy to monitor power supply performance, toggle between single and multiple +12V rail modes, and control fan speed directly from your desktop.
- > **Fully modular cable set** allows for quick and easy installation and great looking builds.
- > **100% Japanese 105° C capacitors** ensure reliability and long life, backed by a 7 year Guarantee.



HIGH PERFORMANCE DIGITALLY CONTROLLED ATX POWER SUPPLY



CASES



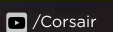
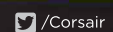
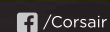
CPU COOLING



DRAM



SSDs



Letters

Please send us your feedback and correspondence to
letters@custompcmag.org.uk

Open door

First off, I love the magazine, especially the mods section, which has come in handy plenty of times! The reason I'm mailing you guys, however, is because I'm stuck with a dilemma. Courtesy of Gumtree, I find myself the proud owner of a near-mint CM Stacker 830 Nvidia Edition case, which is all well and good, but it did come with a downside – the aluminium front door is missing!

That's not a big deal – unlike my old Thermaltake Xaser II case, it doesn't look overly ugly without the door, but the more I look at it the more it bugs me. Is there a way to easily find spares for cases no longer under manufacturer support? And if not, is it possible to make a new door using acrylic or another wonder material without it looking too much like a bodged job?

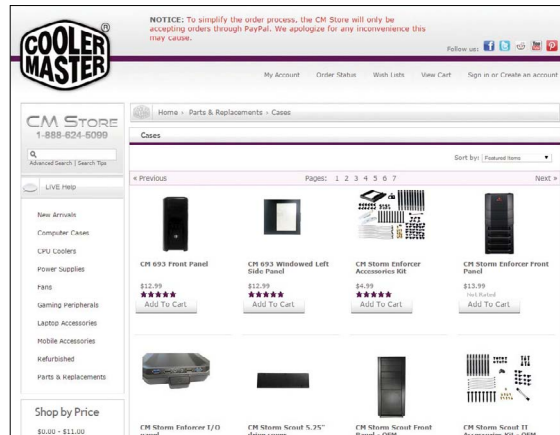
BEN FORD

Ben: I feel your pain Ben – I had the same issue when the removals guys broke the door on my old Antec P182 SE, which was also a special edition case. Many case manufacturers, including Cooler Master, offer spare parts for their current cases, and some of their older ones too (there's a large catalogue at www.cmstore-usa.com/cases), but sadly, the Stacker 830 Nvidia Edition isn't included in the spare parts list. I suggest dropping Cooler Master a line on Twitter, or via email, and straight out asking if there's a spare door for your case somewhere around – it has to be worth a try!



Modder's toolkit

Your mag has inspired me to build my first custom pc, which includes a full custom hardline water-cooling loop with GPU and CPU waterblocks, custom-sleeved



Cooler Master provides spare doors and panels for many of its cases, but only up to a certain age

wiring and some case mods. It's All based on the ASRock Fatal1ty X99m Killer motherboard with an Intel Core I7 5930X processor, NGFF on-board SSD, an AMD R9 290X graphics card and other reviewed items from your mag. At times the build was an absolute nightmare though. Can you please review tools such as crimpers, wire strippers, wire cutters, soldering irons and so on. Could you also provide a list of crimp pin/connector part numbers and manufacturer names?

IMRE GROZNER

Ben: Glad we've inspired you to build what sounds like a great PC Imre, and sorry to hear it's been a nightmare. I really like the idea of looking into the toolkit you need for modding work, though, and I'm sure Antony will be up for it too – I'll see if we can get something together later in the year.



Samsung's SM951 M.2 SSD can offer amazing speeds on Z170 motherboards



M.2 testing

I was reading Issue 143 when I saw something that really annoyed me. On p59 you review the Scan 3XS X99 Carbon Ti and have a little passage talking

about the Samsung m.2 SSD. I know this topic has come up before but I feel the need to raise it again. You claim that the Samsung drive's speed as 'blistering'. Of course, it's blistering when compared with 2.5in SSDs operating via SATA 6Gbps, but that's because this drive is operating on the M.2 bus. No like-for-like comparison is possible because you haven't reviewed any true M.2 SSDs. The closest we get is the Intel 750. If you want to write comments like that you need to do a full Labs on M.2 SSDs.

WILL TAYLOR

Ben: That's a very fair point Will – we do need to take a proper look at M.2 SSDs. We've mainly held off testing M.2 SSDs so far because there were so few that properly use PCI-E bandwidth, rather than simply using SATA with an M.2 connector, and because we wanted to wait for Skylake to come out first. We also had some trouble getting consistently repeatable results from our samples the first time we tried to do an M.2 test earlier this year. Now that Skylake is out, I think it's time we had a proper look at testing M.2 SSDs. Watch this space.



Zen and the art of PC maintenance

Ben, I know that writing an editorial comes with the job, and finding interesting things to write about each issue can sometimes be a challenge. But, it must be said, the last six or so editorials (at least) have been bang on the money.

Take last month's column – it was as if it was written for me personally – about Intel CPUs.

I used to be an enthusiastic Athlon 64 user, but reluctantly switched to Intel when AMD stalled with its CPU development.

Is there a way to easily find spares for cases no longer under manufacturer support?

I last splashed out on a CPU six years back. I went for a Core i7 Nehalem processor and felt fairly chuffed until Intel released the Sandy Bridge range a short time later. That was arguably the last major revision that Intel made, and I missed it! As you hint, since then, progress has been in little dribbles.

But, with a six-year-old processor under the hood, it's time for an upgrade. I was holding off for the Skylake line, but not with much enthusiasm, and your editorial told me why.

Then I glanced at the latest AMD news, and it would seem that things are moving into the fast lane over there – AMD has hired some top-notch brains including the original Athlon designer, with a promise of a new processor range in 2016 called Zen.

At long last I'm excited about a new processor, and next year I want to be back with AMD. I don't know if the chips will only be a match for Intel's CPUs, but the excitement is back and it feels good.

RICK BILLSON



Could AMD's new Zen architecture provide us with some much-needed competition in the CPU market?

Twitter highlights

Follow us on Twitter at @CustomPCmag

2dgame Good review of PC cases, but it would be nice to see a chart showing specs of the cases, how many fans, bays, ports etc.
Ben: I agree – next time we do a case Labs we'll include a specs list in each review, or a feature table.

1974_aj Didn't have the heart to bin my recently deceased P5Q Pro, so I made it into Geek-Art.
Ben: Brilliant – I love this!

aravelle Current reading material. @CustomPCMag I'm a real #nerd now

EckhardMahne Why don't you do a roundup of steering wheels and joysticks? Those on the Elite list are mostly for enthusiasts.

RareCandy The benefits of coming home after uni; collecting my delivered stash of magazines. Thanks lads, can't wait.

Ben: Thank you for your kind words Rick! Indeed, I'm also very interested to see how AMD's new architecture shapes up next year, we could really do with some competition in the CPU market. As James rightly points out on p114 too, while Intel's Skylake CPUs are only a little faster than the Devil's Canyon equivalents, the new Z170 chipset is a reason for some people to upgrade in itself.



PPI claim

I've been eying up a new monitor, and while 4K would be nice, I can't really afford to keep up with the cost of graphics cards that would run games smoothly at that resolution.

I've seen quite a few 2,560 x 1,440 monitors and was looking at a 24 or 25in one, so although it won't be 4K I will get a bit of an increase in ppi. On your hardware travels, have you come across any good but not overly expensive ones?

MATT



Dell has cornered the high-ppi 24-25in monitor market with 2,560 x 1,440 screens such as the U2515H

Ben: Dell has pretty much cornered the 24-25in, high-ppi monitor market at the moment. Its 25in U2515H monitor has an IPS panel and a 2,560 x 1,440 resolution and fits the bill you describe.

Sadly, we haven't tested the Dell U2515H for ourselves yet, so we can't vouch for its quality. However, we did test Dell's 4K equivalent, the 24in UP2414Q in Issue 133, which won an Approved award. **GPC**

WHEN'S THE NEXT MAG COMING OUT?
 Issue 146 of Custom PC will be on sale on Thursday, 17 September, with subscribers receiving it a few days beforehand.



Send your feedback and correspondence to letters@custompcmag.org.uk



TRACY KING / SCEPTICAL ANALYSIS

LOSERS WEEPERS

Are sexist harassers in online games really just sore losers?
Tracy King delves behind the headlines

'Men who harass women online are quite literally losers, new study finds.' Amazing! The basic gist is that in one study, using Halo 3, men who were bad at the game were also the men who were horrible to female players. Men who were good at the game were nice to everyone. The Washington Post summarised this study by saying that 'in other words, sexist dudes are literally losers'.

Well, Washington Post, that's a stretch, or at least, a reversal of what's most likely happening, which is that players who are losing act antisocially. Rather than sexist men being bad at games, it's that losing at a one specific game correlates with sexist behaviour (specifically related to the gaming environment). That isn't such a snappy claim though.

Nonetheless, this sort of research is progress because it adds to the growing pile of evidence, as discussed in this column frequently, that there's a big problem with sexism in gaming culture. My mantra, 'knowing isn't the same as proving', is particularly important when so many people want to insist there's no problem in their beloved hobby, and reject feminism as annoying, unnecessary or disruptive. To quote journalist and gamer Helen Lewis, 'heaven forefend a revolutionary movement should do anything other than validate your existing life choices.'

But what of the study itself? Does it stand up to scrutiny and justify the excited headlines? Published in online open-access journal PLOS ONE, the paper is called Insights into Sexism: Male Status and Performance Moderates Female-Directed Hostile and Amicable Behaviour. The main focus of the theory the study wants to test (but not the main focus

of the media coverage, ho hum) is evolutionary psychology. The argument runs roughly like this: men and women have evolved to have biological differences that are a reflection of early, different needs. While modern society has eliminated many of those needs, biology hasn't caught up, and so we end up with a clash.

That puts a slightly different spin on it, because while many psychological claims are testable, it can be hard to test evolutionary psychology claims. You can posit a theory that a group acts a certain way because of evolutionary throwbacks, such as fighting over resources that used to be scarce when we were still doing the bulk of our evolving, but you can't prove it with direct testing because we don't have any earlier versions of homo sapiens on which to test (or a handy time machine). The best you can do is theorise around an observation.

However, in the case of this study, the data itself (which came from a different 2013 study) is sound. In the case of the Halo 3 study, the majority of vocal players (those who speak during a game) are male. Players weren't recruited for the study; instead, the researchers used real online players (all of whom were anonymous and unaware they were being studied), so there was no participation bias. The coding of whether a comment in response to a female player was positive, negative or neutral is an area that can be at risk of bias, particularly as it's done using transcriptions of gameplay where tone of voice isn't present, but the study design accounted for this issue as far as possible.

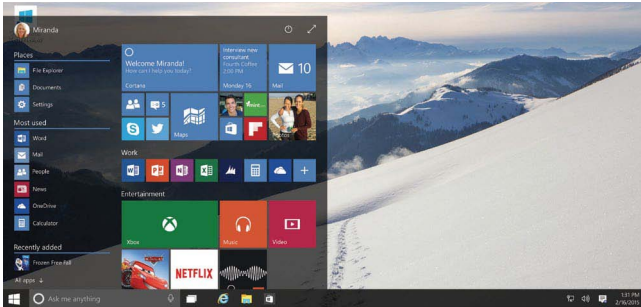
I'd like to see the study replicated, but as another weapon in the growing arsenal of proof of sexism in gaming, it's not quite a grenade launcher, but better than a plasma rifle. **GPC**

It adds to the growing pile of evidence that there's a big problem with sexism in gaming culture

Gamer and science enthusiast Tracy King dissects the evidence and statistics behind popular media stories surrounding tech and gaming [@tkingdoll](#)

Incoming

We take a look at the latest newly announced products



Windows 10 released

Just as we went to press, Microsoft officially released Windows 10, aiming to unify the Windows OS across various platforms, but without mucking up the desktop experience in the same way as Windows 8. The new OS sees the welcome return of the Start menu as standard, and also introduces DirectX 12, which aims to reduce Windows overheads in games to improve performance, enabling developers to get closer to the silicon, as you would with a console.

We've been playing around with Windows 10, and first impressions look good, but we'll reserve judgement until we've properly tried out the final version. In the meantime, most users of Windows 7 and 8 can get a free upgrade to the new OS anyway. Look out for a full analysis of Windows 10 soon.

BitFenix adds magnets to LED strips

As you'll soon see in our Dream PC Labs test this month (see p40), some simple LED strips can make a big difference to the looks of a PC's innards, but sometimes they can be a faff to fit, using adhesive pads that look unseemly through vents and can easily unpeel. However, BitFenix has fitted its latest Alchemy 2.0 LED strips with magnets, so they automatically stick to a steel case's innards – there's even a magnet in the power plug so it doesn't tug the strip downwards. The strips also come in a range of colours, which you

can chain together to make multi-coloured strips. In addition to the usual colours, BitFenix has also added a purple flavour this time. The LED strips are available to pre-order now from www.overclockers.co.uk, starting at £8 inc VAT for a 120mm, six-LED strip, and going up to £22 inc VAT for a 600mm strip with 30 LEDs.



Roccat unveils 3D printable mouse

Roccat has revealed a novel innovation to help it stand out in the crowded gaming mouse market – a modular mouse with 3D printable parts. The new Nyth can basically be any mouse you want, with a selection of replacement buttons to customise it how you want, but it also includes the necessary tools to get even more parts 3D printed for it, while plans for more parts will be downloadable online.

It's billed as an MMO mouse, as its side can sport a large number of thumb buttons, but you could also fill the side with fewer, larger buttons, and you can even swap out the side grips. The mouse also comes with a carry case to hold 33 replacement buttons and a side grip. Look out for a full review shortly.



EVGA launches USB 3.1 X99 micro-ATX board

EVGA has just revealed a new micro-ATX board based on Intel's top-end X99 chipset for Haswell-E processors, which also supports USB 3.1, complete with a Type-C connector, promising data transfer speeds of 10Gb/sec. Despite its modest dimensions, the EVGA X99 Micro 2 also supports three-way SLI via its three 16x PCI-E slots, and also

includes an M.2 connector, and on-board power and reset buttons. Meanwhile, the ten SATA 6Gbps ports will accommodate loads of storage devices. UK pricing and availability for the Micro 2 have yet to be confirmed.



Reviews

Our in-depth analysis of the latest PC hardware



Reviewed this month

Intel Core i5-6600K and Core i7-6700K p17 / Asus Z170 Deluxe p22 / DDR4 memory test p24 /
Asus Strix Radeon R9 380, 390, 390X and Fury p27 / Corsair Gaming Strafe p31 / Custom kit p38

STOP PRESS!

Intel Core i7-6700K / **£287** inc VAT
and Core i5-6600K / **£199** inc VAT

First test of Intel's Skylake platform

SUPPLIER www.scan.co.uk

Intel's tick-tock strategy has become slightly less predictable recently. The idea is that, in alternating years, Intel first shrinks the lithography of its chips, boosting efficiency, then brings out a new architecture the following year with a focus on performance. The cycle historically repeated every two years. However, the move to 22nm transistors with Ivy Bridge was over three years ago, which is where desktop processors have remained since. The shrink to 14nm with Broadwell (see Issue 143, p18) was so heavily delayed that we ended up with a Haswell refresh, called Devil's Canyon, last year, and now Broadwell has already been superseded by Skylake, Intel's new 14nm CPU architecture.

The new socket is 100 per cent compatible with LGA1150 coolers

Intel's Haswell architecture, the new socket is 100 per cent compatible with existing LGA1150 coolers though.

With Haswell, Intel shifted its focus away from performance gains, looking instead to offer better power efficiency and integrated GPU performance, which was particularly important for mobile chips, as it helped

Intel compete with ARM. Skylake is similar in this respect.

The CPUs are certainly a bit faster than their predecessors, but the biggest changes are the new DirectX 12 Intel HD 530 GPU (which we plan to investigate in a future issue), and the new chipset, (Z170), which adds plenty of new features, including 20 PCI-E 3 lanes (in addition to the 16 lanes in the CPU). The fully integrated voltage regulator (FIVR) that moved on-die with Haswell has been put back on the motherboard as a separate component for Skylake once again, and there's also now support for DDR4 memory and a move from Direct Media Interface (DMI) 2 to DMI 3, while M.2 slots now get access to four PCI-E 3 lanes, rather than PCI-E 2 lanes, improving SSD performance.

The CPUs

Intel's consumer desktop processor launches have become fairly predictable, with the specifications of the new Skylake processors



Intel Core i7-6700K

almost exactly matching the previous generation. The multiplier-unlocked Core i7-6700K and Core i5-6600K are the two high-end mainstays of the new Skylake lineup. Both are quad-core parts, with the Core i7-6700K offering Hyper-Threading, with each physical core splitting its resources across a second virtual core, enabling it to process two threads at once, which isn't offered by the Core i5-6600K.

The Core i7-6700K has a base clock of 4GHz, which exactly matches the Core i7-4790K Haswell processor, although it has a Turbo Boost frequency of 4.2GHz, which is slightly lower than the 4.4GHz of the Core i7-4790K. Meanwhile, the Core i5-6600K has a 3.5GHz base clock and a 3.9GHz Turbo Boost frequency.

Both chips have a TDP of 91W, significantly higher than Broadwell's 65W (although these CPUs have much lower clock speeds), and slightly more than the 88W of the Devil's Canyon chips. As before, the Core i7 chip has 8MB of L3 cache while the Core i5 CPU has 6MB.

As before, the K-series chips are the only ones with unlocked multipliers, and they also allow adjustment of the base clock (B-Clock) for overclocking.

If you haven't been paying attention to every recent change in Intel's CPU architectures, Haswell introduced an alternative way to overclock processors, which was pretty much restricted to multiplier-only overclocking on Ivy Bridge chips. Haswell introduced tuning ratios that overclock the base clock frequency. With Haswell, this was achieved using predefined ratios: 1.0, 1.25 and 1.67, giving you three

/SPECIFICATIONS

Frequency Core i5-6600K: 3.5GHz; Core i7-6700K: 4GHz

Core Skylake

Manufacturing process 14nm

Number of cores Core i5-6600K: 4x physical; Core i7-6700K: 4x physical, 4x logical

Cache L1: 4x 32KB; L2 4x 256KB; L3: Core i5-6600K 6MB, Core i7-6700K 8MB

Memory controller Dual-channel DDR4 up to 2133MHz

Packaging LGA1151

Features SSE, SSE2, SSE3, SSSE3, SSE4, SSE 4.2, EM64T, F16C, Turbo Boost 2, Quick Sync Video

base clock values from which to choose: 100MHz, 125MHz or 166MHz.

With Skylake, however, the base clock can be increased in much smaller increments to allow for much finer tuning of the clock speed. Although it depends on your motherboard, we found that both methods work well for CPU overclocking. You can leave the multiplier alone and increase the base clock, then manually adjust the memory and cache speeds. That last part is quite important; by increasing the base clock, you affect more than just the CPU. It's a system that improves the ability to fine-tune your system. With a 40x multiplier, a base clock increase of 0.5 MHz adds just 20MHz to the overall CPU speed, but add an extra 1x to the multiplier and you increase the CPU frequency by 100MHz.

Performance

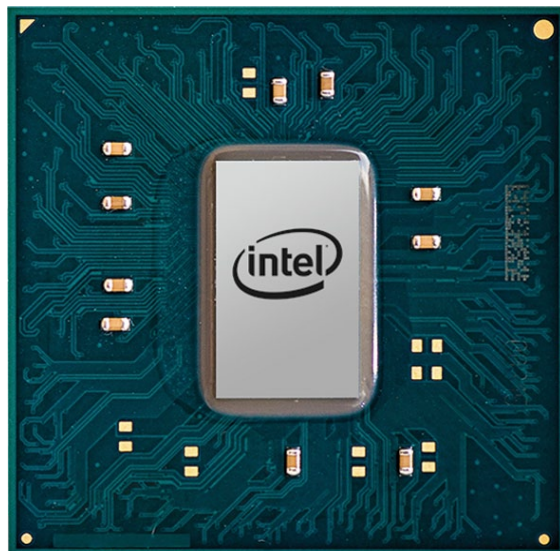
Since the default clock speed of the Core i7-6700K is identical to that of the Core i7-4790K, with the same 4GHz stock frequency, the benchmark results indicate the exact gains in terms of clock-for-clock performance, and it's modest to say the least. The overall result in **Custom PC RealBench 2015** test was 17 per cent higher than the result from our original Core i7-4790K Devil's Canyon reference PC, with a score of 133,939.

A part of that increase is down to the fact that our original test GPU bit the dust, though, so our Skylake test rig used a GeForce GTX 970 rather than the GeForce GTX 780 in the Devil's Canyon machine. This GPU change increased the OpenCL score by 50 per cent, which

slightly affects the overall result.

Looking at the score breakdown gives you a better understanding of the bigger picture. In our image editing test, which is mainly single-threaded and responds well to clock speed increases, the Skylake score is just 5 per cent higher, with a result of 63,527, compared to 60,850 in the Core i7-4790K. However, the heavy multi-tasking result of 162,326 is 14,000 points higher than the 148,078 of the Core i7-4790K, representing a gain of just under 10 per cent.

Skylake is clearly very good at handling multi-threaded work



Intel's new Z170 chipset can allocate four PCI-E 3 lanes to M.2 SSDs



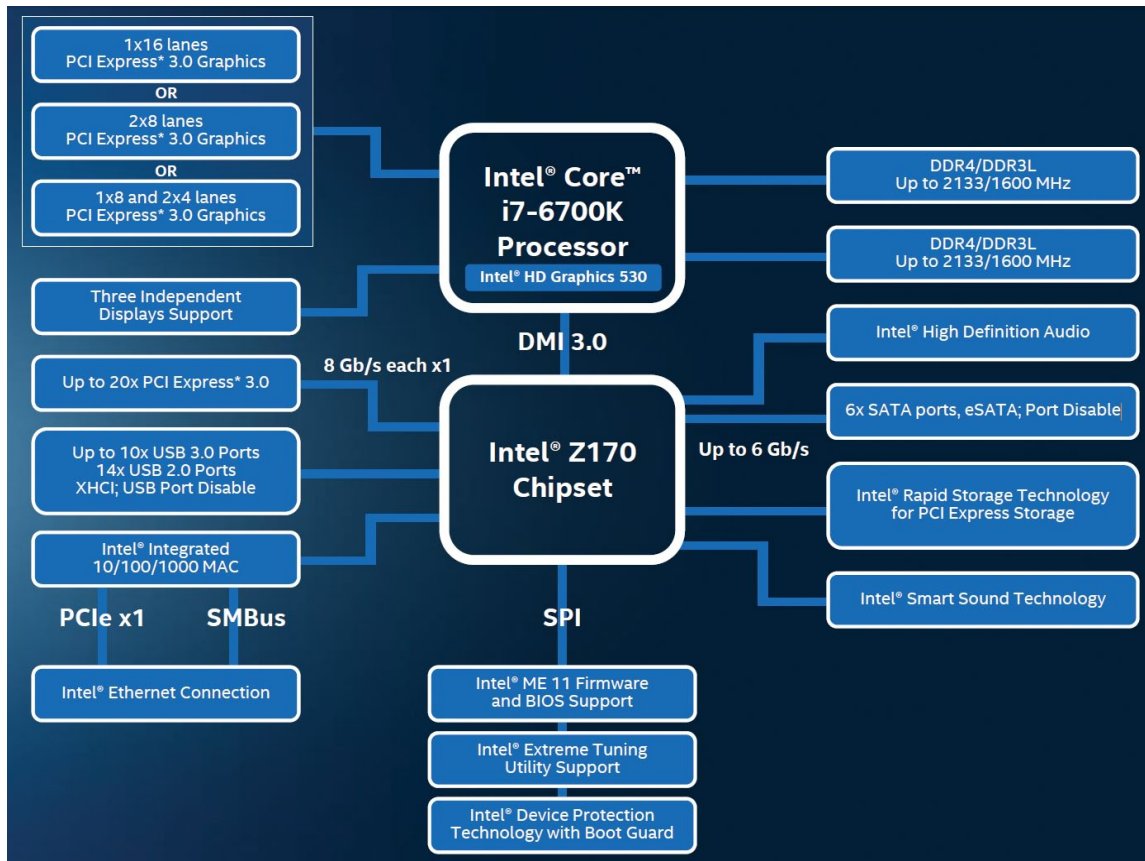
Core i5-6600K

However, there was a more significant gain in our heavily multi-threaded video encoding test, with the Core i7 Skylake chip's score of 297,115 being around 25 per cent higher than the reference score of 231,750. Skylake is clearly very good at multi-threaded work, and it's also helped along by DDR4 memory.

Meanwhile, the Core i5-6600K results were still solid, but noticeably behind the 6700K, with an overall score of 105,124. The image editing result of 53,785 was 10 per cent lower than the reference score from the Core i7-4790K, because of the 6600K's lower clock speed. Meanwhile, the heavy multi-tasking and heavily multi-threaded video encoding results were a fair way behind both the 4790K and the 6700K, as this chip doesn't have Hyper-Threading, and because of the lower stock clock speed.

Overclocking

In the run-up to Skylake's launch, leaked benchmarks and CPU-Z screenshots have showed early chip samples to be capable of some extremely high overclocks, with total figures above 5GHz reported using just air cooling. However, there's usually no mention of system stability or CPU temperatures at these speeds, and a system only needs to boot for a few seconds in order to get a CPU-Z screenshot. With overclocking, you need to know when to stop, and the final frequency on which we settle is the one where the system is stable in Prime95, with temperatures that are within safe limits.



The Skylake platform in detail – major new features are DD4 RAM support, the DMI 3 connection between the CPU and chipset, and loads of PCI-E 3 lanes

Skylake launched just a few days before we went to press, so we haven't had time to really probe what's possible by adjusting every last setting, but we have a pretty good idea. With our test rig, using a Corsair H80i GT all-in-one liquid cooler, we achieved a maximum stable frequency of 4.8GHz from the Core i7-6700K, with a 48x multiplier, a 100MHz base clock and a 1.38V vcore. We also achieved the same speed by leaving the multiplier at 40x and raising the base clock to 120MHz

We also tried a multiplier of 50x with a 100MHz base clock, but Windows wouldn't boot. However, we managed to boot into Windows with a 125MHz base clock and a 40x multiplier, resulting in an impressive clock speed of 5GHz. At this frequency, though, our benchmarking software crashed as soon as it was loaded. With a 122.5MHz base clock and a final frequency of 4.9GHz, the system was mostly stable,

and we were able to run benchmarks, but Prime95 test crashed after a while, and we experienced a few system lockups too.

By default, the Asus Z170 Deluxe motherboard we used for testing automatically sets voltages to what it deems the required levels to reach your chosen overclock, and in the case of our 4.8GHz speed, it set the voltage to 1.48V, which is a little overzealous. While the system was totally stable, the CPU temperature hit 100°C at load, which is simply too high for comfort. Thankfully, the voltage was an overestimation, and with the same settings at 1.38V, the CPU temperature dropped to 89°C under load.

Sadly, our Core i5-6600K sample wasn't as overclockable as its Core i7 counterpart, despite our best efforts in the time available. We achieved a maximum stable frequency of 4.6GHz (46x 100MHz), using a vcore of 1.35V with this chip.

These overlocks pushed up the benchmark scores, but the most impressive overclocked result came from Cinebench with the Core i7-6700K, where its score of 1,053 is now snapping at the heels of results from 6-core chips, again showing the strength of Skylake's multi-threaded performance.

Power consumption

The other factor is power consumption, and as this test was conducted just before we went to press, we were unable to test the Skylake chips with the same power supply we usually use for CPU testing. As such, the total system power consumption figures can't be directly compared



to those from other CPUs we've tested, but they can still give you an indication.

With either chip installed, our test system drew less than 70W from the mains when idle, increasing to around 150W at load. It looks as though Skylake chips draw slightly less power than Devil's Canyon CPUs at idle, and around the same amount at full load, which is a solid result when you consider the improved performance. However, when overclocked, the 6700K system drew a much more significant 267W from the mains.

Conclusion

Skylake is a classic story of evolution rather than revolution. It's an improvement, but based on the modest gains to processor performance at default clock speeds, it isn't worth upgrading if you already have a Z97 motherboard and a top-end Core i7-4790K. If you're using an older platform, though, such as a Sandy Bridge PC, there's a fair amount to

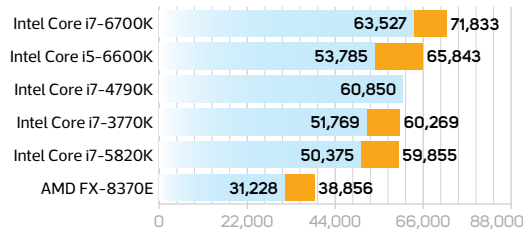
be gained from Skylake, especially if you overclock the Core i7 variant and upgrade to an M.2 SSD.

The overclocked results from the Core i7-6700K are great, particularly in multi-threaded software, and the Z170 chipset promises significant performance from PCI-E M.2 SSDs too (see James Gorbald's column on p114).

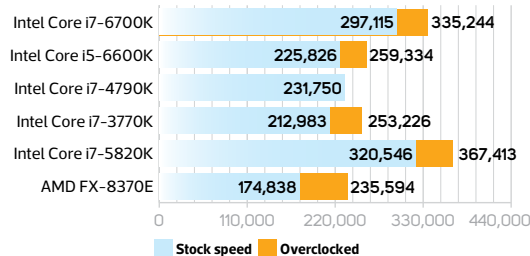
However, given that Skylake represents not one, but two processor generations after Devil's Canyon, we're disappointed that its performance gains are only a small step forward. Given the change in focus for Intel, not to mention the current lack of competition in this segment, we have to wonder if we'll ever see the giant leaps of the past in the mainstream desktop CPU market again. As it stands, though, the Core i7-6700K and Core i5-6600K may not be huge leaps forwards from their predecessors, but they're still the best chips in their league, and are now our mainstream desktop CPUs of choice.

ORESTIS BASTOUNIS

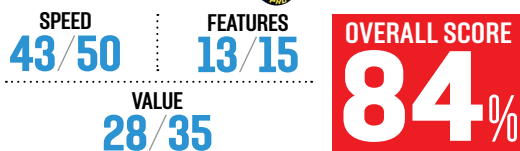
GIMP IMAGE EDITING



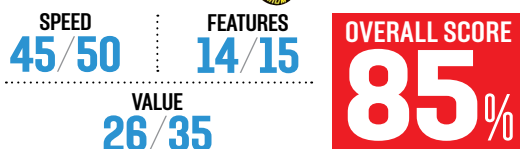
HANDBRAKE H.264 VIDEO ENCODING



CORE i5-6600K



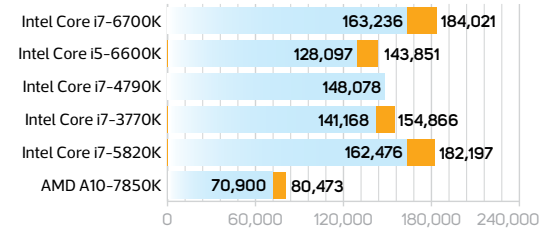
CORE i7-6700K



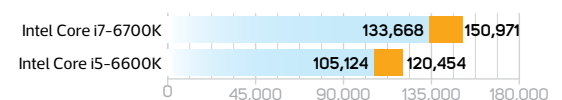
VERDICT

Not a huge leap forwards over Haswell, but the Core i7-6700K offers decent multi-threaded performance, particularly when it's overclocked, and both chips are still the best in their league.

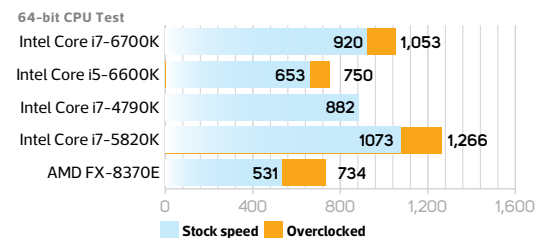
HEAVY MULTI-TASKING



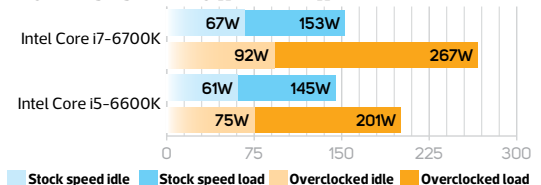
SYSTEM SCORE



CINEBENCH R15

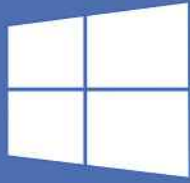


TOTAL SYSTEM POWER DRAW



/TEST KIT

Asus Z170 Deluxe motherboard; 16GB Corsair Vengeance LPX 2666 Hz DDR4 memory; 256GB Samsung 850 Pro SSD; MSI Twin Frozr V GeForce GTX 970 4GB graphics card; NZXT Hale 82 650M PSU; Windows 8.1 64-bit



Windows 10

Available Now

- The fastest Windows ever
- The ultimate gaming platform with Direct X 12
- Familiar yet expanded Start menu
- Beautiful, elegant UI for desktops and laptops



Arkham Knight - Limited Edition

Custom Designed Acrylic Batman:
 Arkham Knight Armour Case
 Intel® Core™ i7-5960X Processor
 Triple radiator Water Cooling System for the CPU
 Gigabyte X99M-Gaming 5 Motherboard
 Dual NVIDIA GeForce GTX 980Ti 6GB
 32GB 2666MHz DDR4 Memory
 512GB Samsung M.2 PCIe SSD
 4000GB Seagate SSHD Hybrid Drive
 Corsair HX1000i Full Modular Digital Power Supply
 Onboard High Definition Audio
 Windows 10 Pro 64bit OEM

From **£4750** inc VAT

Windows 10 and SKYLAKE is here!



FUSION CENTURION

Zalman Z3 Case in Black
 Intel® Core™ i5-6600K Skylake Processor
 Akasa Nero 3 CPU Cooler
 Asus Z170-K Motherboard
 NVIDIA GeForce GTX 750 1GB
 8GB 2133MHz DDR4 Memory
 128GB Samsung M.2 PCIe SSD
 1000GB Hard Disk Drive
 Aerocool 600W Power Supply
 Onboard High Definition Audio
 Windows 10 64bit OEM

From **£649** inc VAT



FUSION NEO

Zalman Z11 Neo Case
 Intel® Core™ i5-6600K Skylake Processor
 Corsair H55 Liquid Cooler
 Asus Z170-K Motherboard
 NVIDIA GeForce GTX 960 2GB
 16GB 2133MHz DDR4 Memory
 128GB Samsung M.2 PCIe SSD
 1000GB Seagate SSHD Hybrid Drive
 Aerocool 600W Power Supply
 Onboard High Definition Audio
 Windows 10 64bit OEM

From **£999** inc VAT



FUSION CORE

Thermaltake Core V51 Case
 Intel® Core™ i5-6600K Skylake Processor
 Corsair H55 Liquid Cooler
 Asus Z170 PRO GAMER Motherboard
 NVIDIA GeForce GTX 970 4GB
 16GB 2133MHz DDR4 Memory
 256GB Samsung M.2 PCIe SSD
 2000GB SSHD Hybrid Drive
 Aerocool 700W Power Supply
 Onboard High Definition Audio
 Windows 10 64bit OEM

From **£1299** inc VAT



FUSION EMISSARY

Fractal Design Define S Case
 Intel® Core™ i5-6600K Skylake Processor
 Fractal Design Kelvin S36 Liquid Cooler
 Asus Z170 PRO GAMER Motherboard
 ASUS STRIX GeForce GTX 960 4GB
 16GB 2133MHz DDR3 Memory
 120GB Samsung M.2 PCIe SSD
 1000GB Seagate SSHD Hybrid Drive
 Corsair RM 750 Semi Active Power Supply
 Onboard High Definition Audio
 Windows 10 64bit OEM

From **£1199** inc VAT

FINANCE AVAILABLE ON ALL SYSTEMS OVER £250*

Terms & Conditions apply. Credit subject to status and affordability.

£15 OFF

ANY CHILLBLAST PC
WITH THE CODE
CUSTOMPC0815

The UK's most awarded PC Builder**

But don't just take our word for it...

-Five time winner of PC Pro Excellence Award!

-Four time winner of PC Advisor Best Desktop Brand!

-Builder of the World's Fastest PC!***

-Computer Shopper & Expert Reviews Best PC Manufacturer 2012



* Credit subject to status and affordability. Credit is provided by a panel of lenders with whom we have a commercial relationship - we are not able to provide independent advice. Terms & Conditions apply. Credit subject to status and affordability.

** Chillblast won more awards in the leading IT press publications PC Pro, PC Advisor and Computer Shopper combined than any other retailer 2010-2013

*** World's fastest PC as tested by PC Pro Magazine <http://www.pcpro.co.uk/reviews/desktops/371152/chillblast-fusion-photo-oc-iv>

Intel, the Intel Logo, Intel Inside, Intel Core, Core Inside, Pentium, and Pentium Inside are trademarks of Intel Corporation in the U.S. and/or other countries.

Terms and conditions are on the website. All trademarks are acknowledged. Pictures are for illustration only. Prices are correct at time of going to press (30-07-15) E&OE

LGA1151 MOTHERBOARD

Asus Z170 Deluxe / £245 inc VAT

SUPPLIER www.scan.co.uk

As with nearly every other modern Intel processor launch, a new architecture introduces a new socket type, breaking compatibility with existing motherboards, and making a new motherboard mandatory if you want one of the new chips. In the case of Skylake, the new socket is called LGA1151, and the motherboards use the new 100-series chipsets. At the top end is the Z170 chipset; however, as with previous chipset launches, there will be cheaper variants with slightly fewer features as well.

It's early days for Skylake, so you can expect a wide range of Z170 boards from just about every manufacturer to go on sale soon, and you can be sure to read about more of them in **Custom PC**. However, as the launch of Skylake was so close to our print date, very few boards were available to test. Asus was quick off the mark getting the feature-laden Z170 Deluxe into our hands though.

The I/O section houses six USB 3.1 ports

The Z170 chipset

The key changes to the Z170 chipset are DDR4 memory support, more 8GB/sec PCI-E 3 lanes, better system-level

support for M.2 devices, and improved granularity for overclocking using the base clock (B-Clock) frequency and for memory overclocking.

The chipset now has 20 PCI-E 3 lanes, up from 18 in Z97, in addition to the 16 lanes for graphics cards in the CPU, which allows a variety of configurations, including adding an extra single graphics card in a 16x configuration (or a pair of cards in 8x configuration) with enough lanes to spare for a

4x M.2 device. There aren't any consumer 4x M.2 drives available yet (the Samsung SM951 is a 4x PCI-E 3 enterprise SSD) but when they're available, Z170 will enable you to get full speed from it, with an interface that can transfer data at up to 32Gb/sec, removing a serious storage bottleneck from the system.

M.2 support at the system level also means easier booting from an M.2 device, and support for creating a RAID array.

As we found when overclocking the Skylake processors, using the base clock to increase the CPU frequency is now very flexible.



Previously you only had a number of straps from which to choose: 1:1:133 and 1:166, but now you can adjust the frequency in 0.5 MHz increments if you wish. You don't get the same level of control over memory overclocking, but the granularity has been improved in this respect too, with increments of 100/133MHz rather than 200/266MHz.

Layout and features

Although new features have been introduced, the layout of Asus' Z170 Deluxe isn't far removed from equivalent Z97 motherboards. There are three 16x PCI-E slots (supporting two-way SLI and three-way CrossFire) and four 1x PCI-E slots. One of the 1x slots is located above the top-most full-length slot, with two more underneath it, giving additional space for portly graphics cards with large coolers.

A protective white plastic cover shields the top of the rear I/O ports, to match the white heatsinks for the VRMs. This I/O section houses six 10Gb/sec USB 3.1 ports thanks to an ASMedia ASM1142 controller (plus a USB 3 port and a USB 2 port), and one of the 3.1 ports has the newer, smaller type-C connector rather than a traditional type-A connector. USB type-C connectors double up as 40Gb/sec Thunderbolt 3 ports as well, with the ability to carry a DisplayPort video signal. There are also two video outputs: HDMI 2 and DisplayPort 1.2, so the Z170 Deluxe can output to three displays at once, and output to a 4K TV at 60Hz using your CPU's integrated graphics.

Meanwhile, there are six SATA 6Gbps ports (controlled by the Z170 chipset) on the right-hand side, with a handy 'OS Drive' label next to the first SATA port. There are two more SATA ports (courtesy of a third-party controller) and a SATA Express port next to it, along with an M.2 connector, which supports all the various length and shapes of M.2 devices.

/SPECIFICATIONS

Chipset Intel Z170

CPU socket Intel LGA1151

Memory support 4 slots: max 64GB DDR4 (3466MHz OC)

Expansion slots Three 16x PCI-E 3, four 1x PCI-E 3

Sound Asus Crystal Sound 3

Networking 2 x Intel Gigabit LAN, 3x3 802.11ac Wi-Fi

Overclocking Base clock 40–400MHz, CPU multiplier 8–33x; max voltages, CPU 1.7V, RAM 2V

Ports 6 x SATA 6Gbps (Z170), 2 x SATA 6Gps (third-party controller) 1x SATA Express, 1x M.2, 1x USB 2, 1x USB 3, 6 x USB 3.1 (ASMedia ASM1142 controller), 2x Gigabit LAN, surround audio out, line in, mic

Dimensions (mm) 305 x 244



1

Up to 64GB of DDR4 memory is supported by the four DIMM slots

2

The M.2 socket can provide 32Gb/sec of PCI-E 3 bandwidth to SSDs

3

A SATA Express connector sits next to the stack of SATA 6Gbps ports

In the box you also get a pair of adaptors, one for NVMe U.2 devices (for connecting 2.5in PCI-E SSDs). The other adaptor is a PCI-E-form-factor card with another 4x M.2 slot on it, so you can have two M.2 drives in the same system, perhaps for a RAID array or indeed other types of M.2 device.

As Z170 still supports dual-channel memory, rather than the quad-channel memory systems supported by Intel's enthusiast platforms, there are still just four memory slots. However, these slots take DDR4 memory with a frequency of up to 3466MHz in Asus' OC mode, and you can install up to 64GB (4 x 16GB) of RAM too.

Meanwhile, Asus offers built-in wireless via a mini card, supporting Bluetooth 4 and 3x3 802.11ac (1300Mb/sec) speeds, which is a great thing to see given how most PC manufacturers seem content with 2x2 802.11ac (866Mb/sec) adaptors. An oddly shaped external plastic antenna unit is included. Finally the standard audio connectors support 8-channel DTS, and there's also a PS/2 connector for legacy peripherals.

The EFI

The Asus EFI has the usual split between Advanced and Easy mode, with quick shortcut access to boot menus and so on. The AiTweaker menu, as always with Asus, is where you'll find the options to overclock the processor, memory and adjust voltages, while the Advanced CPU menu lets you turn off features such as Turbo Mode and Hyper-Threading.

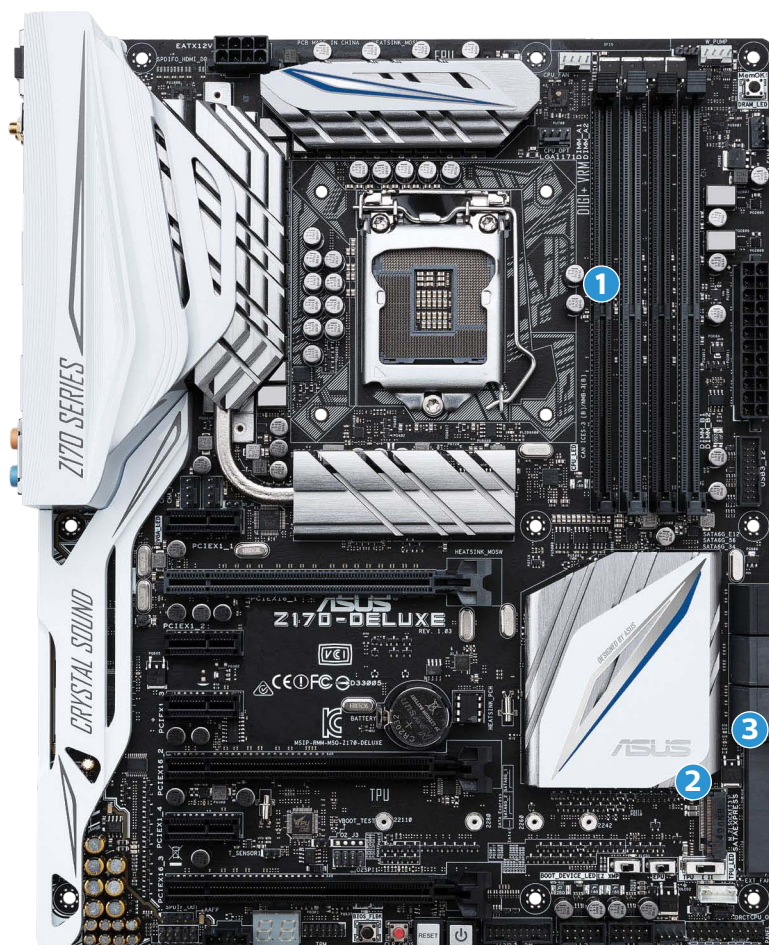
As with the Maximus Z97 motherboards, SSD Secure Erase is built in, offering a wonderfully simple way to restore an SSD to full performance, without having to mess about with Linux commands or third-party software. The similarly useful Asus EZ Flash 3 system also allows you to flash the motherboard's firmware without needing a processor installed, and there's now the ability to download a new BIOS directly from the internet without having to copy it to a USB stick first.

Overclocking is really simple with a K-series Skylake CPU, with no more than two settings to change, switching the multiplier mode from Auto to 'Sync All Cores' and the desired value of the multiplier. As previously stated, you can overclock by adjusting the base clock as well. This second method also overclocks the cache, which you can adjust back again with a further setting, while you'll also need to ensure the memory is still running at its correct speed.

By default, all the voltages are set to Auto and will be raised as soon as you save the EFI settings and reboot. We found the Z170 raised the voltage quite high with more extreme overclocks – to 1.477V, which resulted in CoreTemp showing temperatures of 100°C, but we reduced this setting to 1.38V with no loss of stability, but a lower temperature.

Conclusion

Without any other Z170 boards available for comparison at the time of testing, it's hard to say conclusively that the Asus Z170 Deluxe is a true performance champion (it was our



Skylake test board, so you can see the performance results on p20), but at this point, its range of features sets a high standard for others to follow.

It gives plenty of headroom for overclocking, and the EFI is well designed with nifty features such as EZ Flash 3 and SSD secure erase, as well as full 3x3 802.11ac Wi-Fi and loads of USB 3.1 ports.

However, it's the M.2 support that really sets the Z170 chipset apart from the crowd, as it's the first consumer-grade motherboard to support 4x PCI-E NVMe SSDs, and the performance is fantastic.

Of course, the Asus Z170 Deluxe is also a premium motherboard, and cheaper Z170 boards will follow suit, but it justifies its price with a solid layout, as well as loads of genuinely useful features, making it a solid Skylake board for us to recommend if you're looking to build a premium Core i7-6700K Skylake build. For everyone else, though, keep an eye out for reviews of more Skylake motherboards in our next issue.

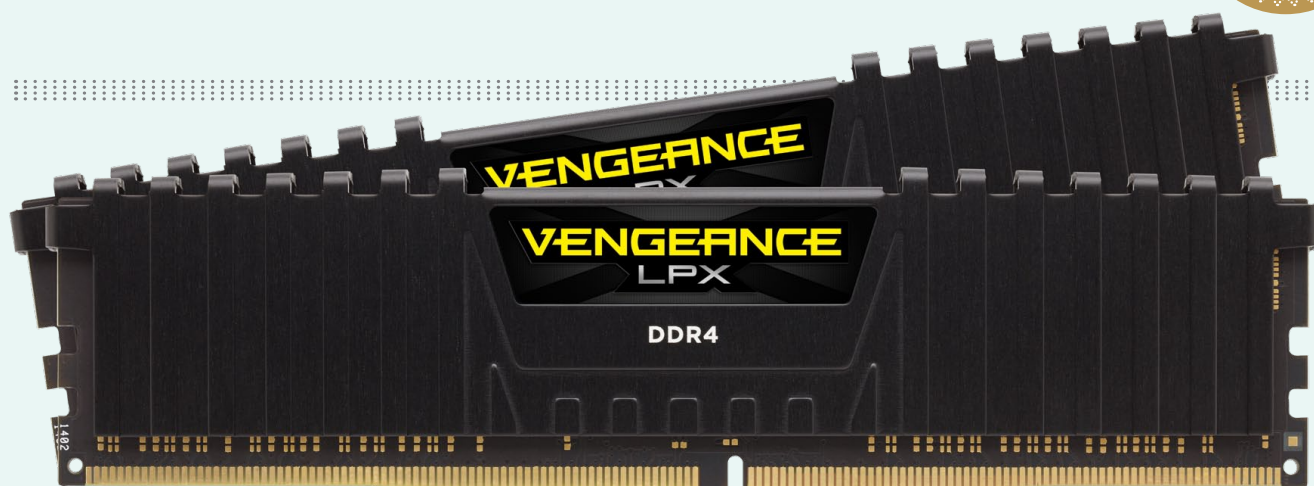
ORESTIS BASTOUNIS

SPEED
38/40

FEATURES
27/30

VALUE
22/30

OVERALL SCORE
87%



DDR4 memory

Skylake brings DDR4 into the mainstream. Orestis Bastounis investigates

New memory standards are launched far less frequently than new microprocessors, graphics cards or chipsets, so the use of DDR4 with 100-series chipsets and the Skylake platform is a milestone, being the first time a consumer chipset has used this type of memory. DDR3 has been around since 2007, where support for it debuted with Intel's P35 chipset. With speeds ranging from 1333MHz up to over 2000MHz, the standard was a faster, more efficient evolution from DDR2 rather than a brand-new technology. SDRAM itself has been around for decades, with only relatively minor tweaks along the way.

DDR3 runs at 1.5v or 1.35v in its 'DDR3L' guise, while CAS latency times range between 7ns and 10ns depending on the module speed. A general rule is that faster memory has a higher CAS latency, but this difference is mitigated by the fact that faster clock frequencies have a much bigger impact on performance than latency timings.

When it launched, DDR3 was really expensive, and inflated the cost of upgrading to a new platform, but prices quickly normalised to the levels of its predecessor. The introduction of DDR4 follows a similar pattern. Speeds now range between 2133MHz and 3200MHz, with CAS latencies around 14ns. The required voltage has dropped to 1.2V and the modules use 288 pins, rather than DDR3's 240 pins, preventing clumsy PC builders from accidentally putting the wrong type of memory in their computer.

Skylake supports both DDR4 and DDR3L, but Intel has stressed that DDR3L is only intended for low-cost devices where the use of DDR4 would inflate retail prices more than necessary. For gamers, or anyone buying a

next-generation computer, DDR4 is the only way to go. If you weren't aware, DDR3L and DDR3 are two entirely separate standards, so it's unlikely you'll be able to use your existing DDR3 memory in a Z170 PC anyway.

But thankfully, although DDR4 prices were initially high, they're falling quickly. There's still a small difference; 16GB of DDR4 RAM is very roughly 33 per cent more expensive than the same amount of DDR3 memory, but the price difference isn't prohibitive.

Z170 also supports DDR4 modules with higher capacities than standard DDR3 modules. A DDR3 DIMM doesn't have any more than 8GB of memory on it, giving you a maximum of 32GB in a consumer system with four memory slots. However, DDR4 modules have higher-capacity modules, with 16GB and 32GB DIMMs already on the market, and even mainstream Z170 motherboards such as the Asus Z170 Deluxe (see p22) supporting up to 64GB of RAM.

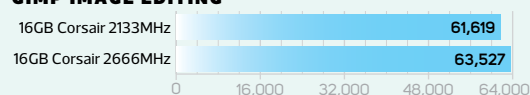
Unless you're running loads of virtual machines, you're unlikely to need so much memory at the moment, but 16GB kits now offer a good sweet spot for dual-channel systems.

The last question concerns frequency, so we ran our Realbench 2015 test suite on a 16GB Corsair Vengeance LPX dual-channel DDR4 kit (pictured) running at both 2666MHz and 2133MHz. As we've seen before with memory tests, the performance difference wasn't huge, but it was noticeable, particularly in our Gimp image editing test, which loads several high-resolution images into memory at the same time. In this test, the jump from 2133MHz to 2666MHz memory resulted in a 3.1 per cent performance increase. The difference was less pronounced in our other tests, but the end system score of 133,668 was still a few points ahead of the 132,978 from the 2133MHz memory.

As such, it's fair to say that most people can get away with using slower memory without it having a drastic effect on real-world performance. However, at the time of going to press, 2666MHz DDR4 memory is very reasonably priced, with just £3 separating the price of a 16GB 2666MHz Corsair Vengeance LPX dual-channel DDR4 kit and the same kit running at 2133MHz. As such, we recommend going for the former, which is available from www.scan.co.uk (model CMK16GX4M2A2666C16) for £102 inc VAT.

CPC MEDIA REALBENCH 2015

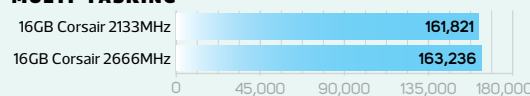
GIMP IMAGE EDITING



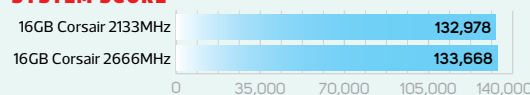
HANDBRAKE H.264 VIDEO ENCODING



MULTI-TASKING



SYSTEM SCORE



OVERCLOCKERS UK

www.overclockers.co.uk



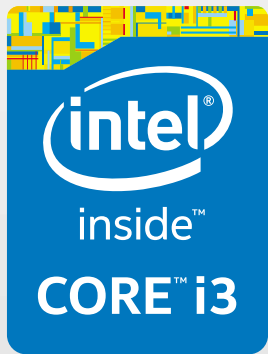
SMALL AND MIGHTY

3 YEARS WARRANTY AS STANDARD • HAND PICKED COMPONENTS • BUILT & TESTED BY THE EXPERTS

TITAN ELECTRON

AN ULTRA SMALL FORM FACTOR GAMING MACHINE, THAT PACKS A PUNCH & OFFERS HUGE CUSTOMISATION, WITHOUT COMPROMISE.

PC does not come with controller or monitor.



Built for Pros with Intel Inside®



ATOMIC

ALL NEW SMALL FORM FACTOR GAMING PCS

TITAN ELECTRON

STOCK CODE: FS-089-OG

- Intel Core i3 Processor 4430 @ 3.5GHz
- Asus H81I Mini-ITX Motherboard
- Raijintek Aidos Black CPU Cooler
- Up to 16GB DDR3 1600MHz RAM
- Configurable SSD & HDD options
- NVIDIA or AMD graphics
- Windows 10 ready

PRICES FROM UNDER
£474.99



TITAN QUARK

STOCK CODE: FS-093-OG

- Intel Core i5 Processor 4690 @ 3.6GHz
- MSI Z97I AC Mini-ITX Motherboard
- Raijintek Aidos Black CPU Cooler
- Up to 16GB DDR3 2400MHz RAM
- Configurable SSD & HDD options
- NVIDIA or AMD graphics
- Windows 10 ready

PRICES FROM UNDER
£599.95



TITAN PHOTON

STOCK CODE: FS-092-OG

- Intel Core i3 Processor 4430 @ 3.5GHz
- Asus H81I Mini-ITX Motherboard
- Phanteks PH-TC12LS 120mm CPU Cooler
- Up to 16GB DDR3 1866MHz RAM
- Configurable SSD & HDD options
- NVIDIA or AMD graphics
- Windows 10 ready

PRICES FROM UNDER
£639.95



www.overclockers.co.uk ■ tel: 01782 444 455

Overclockers UK | Unit 5 Lymedale Cross, Newcastle-under-Lyme, Staffordshire, ST5 9BT

Prices correct at time of print but may change without prior notice. All items subject to availability. Specification may vary.
Intel, the Intel Logo, Intel Inside, Intel Core, and Core Inside are trademarks of Intel Corporation in the U.S. and/or other countries.

The Home Of Award Winning Computer Systems

6th Generation Intel Systems Available Now!



Eclipse H170 Eco Gamer



Intel 6th Gen i3 or i5 Processor,
Asus H170 Motherboard,
Up To 32Gb DDR4 Memory,
Choice of Gaming Cases,
Microsoft Windows 10,
USB 3.0 Connectivity,
3 Year Warranty

From **£499.95** Inc VAT

SuperNova i5r390oc



Intel 6th Generation Core i5
Processor Overclocked
XFX Radeon R9 380 Graphics
Asus Z170 Motherboard,
16Gb DDR4 Gaming Memory,
2Tb Seagate Barracuda HDD,
250Gb Solid State Drive,
26" Monitor, XFX Case
And more...

From **£999.95** Inc VAT

eXtreme Intel XXX SLi



Intel Core i5 or i7 Processor,
Asus Maximus Motherboard,
DDR4 HyperX Gaming Memory,
Corsair Water Cooler,
2 NVIDIA GTX Graphics Cards,
Choice of Gaming Cases,
Microsoft Windows 10,
USB 3.0 Connectivity,
3 Year Warranty

From **£1439.95** Inc VAT

eXtreme XFire X99



Intel Core i5 or i7 Processor,
Asus Rampage Motherboard,
Quad DDR 4 Memory,
Corsair Water Cooler,
Professionally Overclocked,
2 Radeon 300 Graphics Cards,
Microsoft Windows 10,
USB 3.0 Connectivity,
3 Year Warranty

From **£1649.95** Inc VAT

You Spec It... We Build It...

Over 240,000 Systems Configured Online & Counting...

www.eclipse-computers.com



COMPONENTS



PERIPHERALS



SOFTWARE



OVERCLOCKING BUNDLES



MOBILE COMPUTING



COMPUTERS

GRAPHICS CARDS

Asus Strix Radeon R9 Fury, 390X, 390 and 380

Radeon R9 380 / **£176** inc VATSUPPLIER www.scan.co.ukRadeon R9 390X / **£396** inc VATSUPPLIER www.overclockers.co.ukRadeon R9 390 / **£300** inc VATSUPPLIER www.overclockers.co.ukRadeon R9 Fury / **£450** inc VATSUPPLIER www.scan.co.uk

It's clearly still built for 1080p, but at this resolution it really shines

Over 3.5 years ago AMD hit back at Nvidia with its killer GPU architecture, Graphics Core Next, with the Radeon HD 7900 series, and it seems to have been stuck in that time warp ever since. Since then, we've seen the Radeon R9 200-series and now the 300-series, but despite a few tweaks here and there, they still use the same fundamental GPU architecture. In terms of features, all of the current range support Vulkan, OpenCL 2, DirectX 12, OpenGL 4.5, Mantle and FreeSync. Is this enough to compete with Nvidia, which has released both its Kepler and Maxwell GPU architectures in the same time frame?

The first point of interest is that, with the exception of the AMD-made Fury X cards (see Issue 144, p18), AMD doesn't have a reference design for any of the 300-series cards.

There's no reference PCB or cooler and, significantly, for the most part, there's no reference GPU clock speed either – AMD simply gives a guideline of what the clock speed should go 'up to'. As such, the PCBs, coolers and clock speeds are pretty much up to the board manufacturers.

To get an idea, though, Asus has sent us four new cards based on the chips.

These Asus cards represent the cream of the crop if you're willing to spend more cash for a premium card with a quiet cooler and high clock speeds, but you can also buy cheaper 300-series cards from other manufacturers, with a variety of clock speeds.

Radeon R9 380

Let's start with the Radeon R9 380, codenamed Antigua Pro, which starts at around £155 inc VAT, with our Asus Direct CU II OC test sample coming in at £176. It's basically a reworking of AMD's Radeon R9 285, with 1,792 stream processors, but with a clock speed boost from the 285's 918MHz clock. AMD states the R9 380 can be clocked up to 970MHz, but our Asus sample runs at 990MHz.

The Strix sample we tested uses Asus' Direct CU II cooler, which looks quite simple compared with the Direct CU III coolers used on the other cards on test, with just two large fans. As with all the Strix cards on test this month, the fans only spin up when the GPU needs cooling, so it's silent when idle.

It's a well-made card, with a solid backplate, and

a handy LED by the PCI-E power connector to tell you when it's properly hooked up. AMD states that 380 cards can have up to 4GB of GDDR5 memory, accessed via a 256-bit interface, but Asus' card has 2GB of 1375MHz (5.5GHz effective) GDDR5 memory; in fairness, this is all you'll need for the resolutions for which this GPU is designed.

We weren't expecting amazing results from the R9 380 after the R9 285's performance in our last GPU Labs test, but the clock speed boost seems to have given it the necessary push to justify its price. It's clearly still built for 1080p, but at this resolution it really shines, particularly in Alien: Isolation, where its frame rate never dropped below 71fps. It maintained frame rates above 30fps in all our other test games at this resolution too, never dropping below 33fps in Shadow of Mordor, while the Nvidia GTX 960 could only just manage a borderline playable 25fps in this game.

Unlike the Radeon R9 285, the 380 also (just) passed our 25fps borderline playable barrier in Battlefield 4 at 2,560 x 1,440, with a minimum of 26fps, although the only other game it could handle well at this resolution was Alien: Isolation. Comparably, the Radeon R9 280, which had a slightly different stream processor arrangement and a wider memory interface, could also hit a playable frame rate in Shadow of Mordor at 2,560 x 1,440, which was too much for even the Radeon R9 380. However, as the 280 is no longer available, and as the R9 380 hits more of our minimum frame rate targets than the GTX 960, it's now our sub-£200 GPU of choice.

The GPU didn't get too hot either, peaking at 69°C (a 45°C delta T), and the cooler on the Asus card was very quiet throughout testing too and, unlike the 390 cards, it wasn't too hot to touch afterwards either. As with the other cards on test, its Achilles' heel is power efficiency, although it's better than the 390 cards in this respect. Our test system drew 299W from the mains with the 380 card installed and running Unigine Valley, compared to 228W with a reference GTX 960 installed – a difference of 71W.

In terms of performance for bang per buck, though, the Radeon R9 380 is the slightly better GPU, and the Asus Direct CU II package is well built, fast, quiet and not too pricey either, earning it a solid thumbs up from us.

Radeon R9 390 and 390X

Next come the 390-series cards, codenamed Grenada, which are



based on the previous 290 and 290X GPUs. The 390 has 2,560 stream processors and AMD states it can be clocked at up to 1GHz, although our Asus sample comes factory-overclocked to 1,050MHz, and you can get an extra 20MHz from it in OC mode, by installing Asus GPU Tweak software. Comparatively, the 290 had a 947MHz reference GPU clock. Meanwhile, AMD says the 390X can be clocked at up to 1050MHz, with Asus taking this up to 1070MHz (or 1090MHz in OC mode), compared to the 1GHz 290X, and it has 2,816 stream processors. Both GPUs also come paired with 8GB of GDDR5 memory as standard.

Given that the 290X was already hot-running and power hungry, though, those specs are going to require some serious cooling, and Asus intends to tame the heat with its Direct CU III cooler. This monstrous cooler has three cooling fans, which again only spin up when needed, and it also has a solid backplate, and a serious-looking heatpipe and fin arrangement. Both the Strix Direct CU III 390-series cards are seriously well built and designed and, as with all the Asus cards on test, they're also built using Asus' automated Auto Extreme process, which the company says creates a flux-free PCB and makes the boards more reliable.

The cards are also designed to run at 100 per cent GPU load with the fans only spinning up to 45 per cent of their

maximum speed to keep down the noise. This system works too – when running at full load, the fans were barely audible, which is quite an achievement when you consider the heat they're combating.

Designed to run games at 2,560 x 1,440, the Asus R9 390 blitzed through our benchmarks at this resolution, regularly beating or snapping at the heels of the reference GTX 970. Its minimum of 45fps in Battlefield 4 was a particularly good result, when the reference GTX 970 and 980 cards could only maintain 36fps and 42fps respectively. The Asus 390 even managed a 31fps minimum at 4K in this game, while neither the GTX 970 or 980 could hit the 30fps minimum target. Likewise, the R9 390 also managed a 35fps minimum in Shadow of Mordor at 4K, while the GTX 970 could only manage 27fps.

In other tests, such as Crysis 3 and The Witcher III, the GTX 970 had the edge, though, and it also has the benefit of being able to run the latter game with HairWorks enabled without suffering a large performance penalty. It all adds up to a very fast

graphics card, and the £300 inc VAT for this well-made, powerful Asus card gives you a decent bang per buck ratio.

Meanwhile, the 390X card didn't offer a significant advantage over the 390 in most of our tests, despite costing nearly £100 more, a result of the two cards having much closer clock speeds than the reference 290 and 290X designs. The one test where it had a benefit was in The Witcher III at 4K, where it hit our 25fps minimum target, compared to the 390's 24fps.

There's a price, though, and it comes in the form of heat and power consumption. We measured a peak GPU temperature of 82°C at load (a 58°C delta T), which is hot but still manageable – the GPU will be fine at this temperature. However, both coolers were extremely hot to touch after testing, even in our open-case test rig – you'll want to install

ASUS STRIX RADEON R9 380 DIRECT CU II OC 2GB



SPEED
29/40

VALUE
33/40

FEATURES
8/10

EFFICIENCY
5/10

OVERALL SCORE

75%

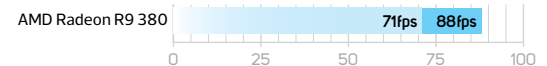
these cards in a case with decent airflow, especially if you're planning a CrossFire setup. Clearly, noise is Asus' priority, and it's one we share, but these cards do get seriously hot.

The monster, though, is power consumption. Our system drew a whopping 428W from the mains with the 390 installed – a good 138W more than a standard GTX 970 card – and an obscene 463W with the 390X card installed – 168W more than a standard GTX 980 card. As a point of comparison, with a reference 290 card installed our test system consumed 368W in the same test, so that extra

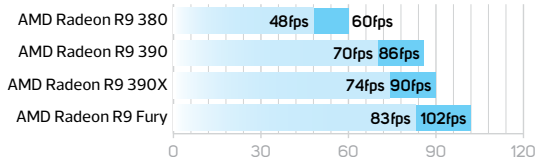


ALIEN: ISOLATION

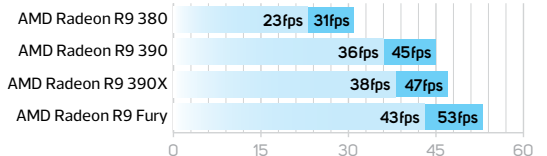
1,920 x 1,080, Ultra detail, SMAA T2x



2,560 x 1,440, Ultra detail, SMAA T2x

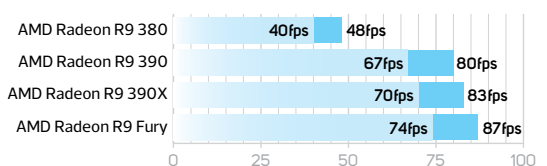


3,840 x 2,160, Ultra detail, SMAA T2x

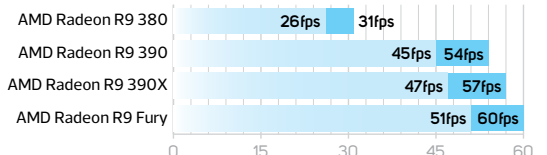


BATTLEFIELD 4

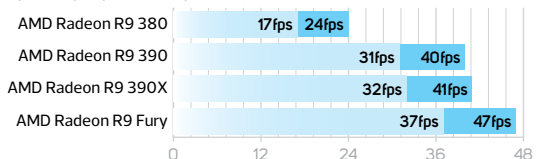
1,920 x 1,080, Ultra detail, 4x MSAA



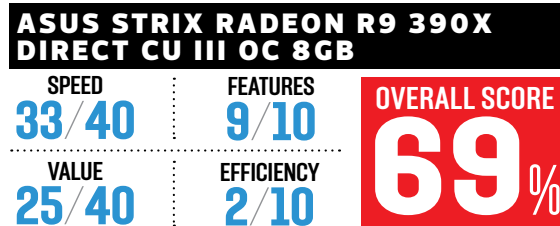
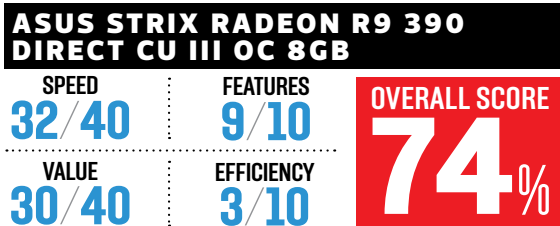
2,560 x 1,440, Ultra detail, 4x MSAA



3,840 x 2,160, Ultra detail, 0x MSAA



Minimum Average



clock speed is seriously pushing up the power consumption.

If power efficiency isn't as important to you as pure frame rates, then this Radeon R9 390 card definitely gives Nvidia's GTX 970 a run for its money, managing to offer smoother frame rates in some games at 4K. However, the R9 390X card can't justify its much higher price with such a small increase in performance.

Also, the power efficiency is a serious trade-off at this level, which is a shame, as the Asus Direct CU III coolers are obviously adept at keeping hot-running GPUs in check,

amazingly without making loads of fan noise, and these cards are well built too – a Direct CU III GeForce GTX 900-series card would definitely be worth considering. At this price, though, the GTX 970's significantly lower power draw makes it a better buy than the R9 390, and the pricier 390X is barely any faster and even more power-hungry.

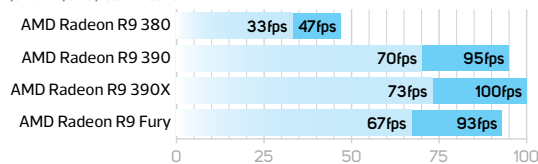
AMD Radeon R9 Fury

Finally, we have the most interesting GPU in the line-up, the vanilla Fury without the X suffix. As with the Fury X, the Fury

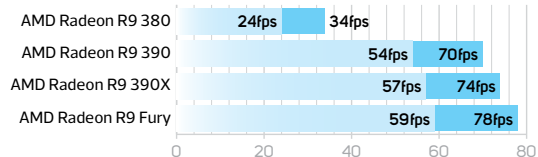


MIDDLE EARTH: SHADOW OF MORDOR

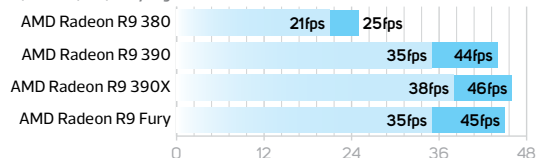
1,920 x 1,080, Ultra detail



2,560 x 1,440, Ultra detail

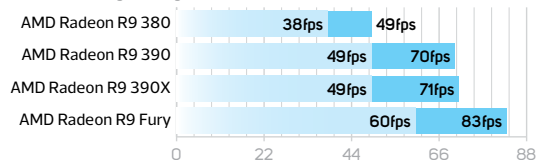


3,840 x 2,160, Very High detail

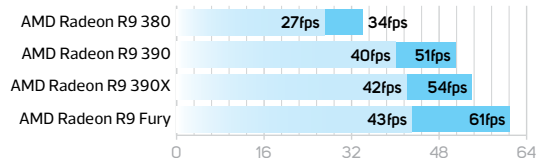


THE WITCHER III: WILD HUNT

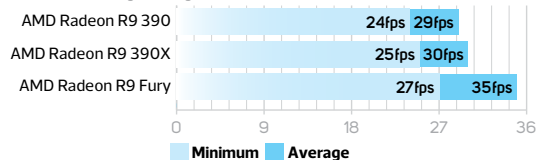
1,920 x 1,080, High settings, HairWorks Off



2,560 x 1,440, High settings, HairWorks Off

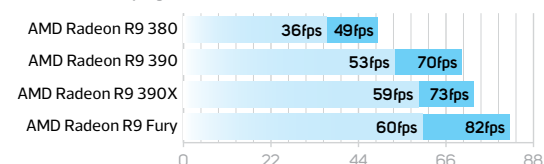


3,840 x 2,160, High settings, HairWorks Off

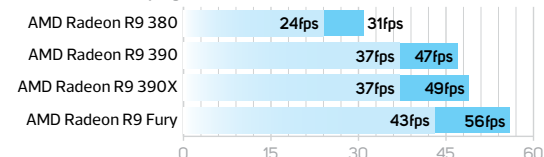


CRYSIS 3

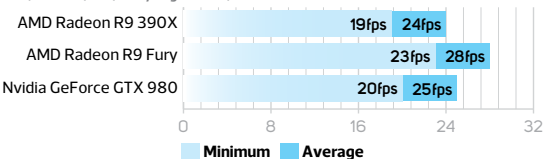
1,920 x 1,080, Very High detail, 0x AA



2,560 x 1,440, Very High detail, 0x AA

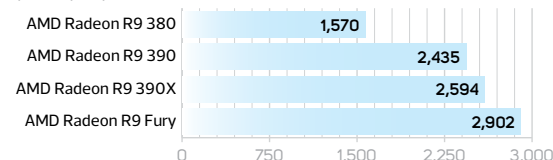


3,840 x 2,160, Very High detail, 0x AA

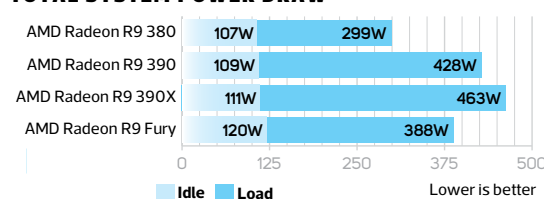


UNIGINE VALLEY

2,560 x 1,440, Ultra detail



TOTAL SYSTEM POWER DRAW

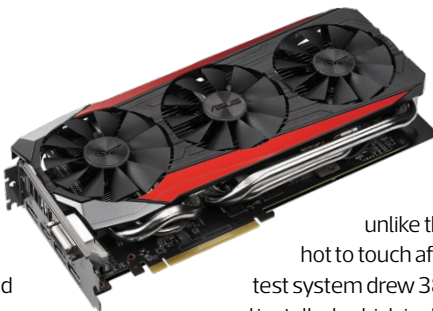


is based on AMD's new Fiji design, which maintains the Graphics Core Next architecture, but incorporates 4GB of high-bandwidth memory (HBM) into the GPU package, without the need for multiple GDDR5 chips spread over the PCB.

In the case of the Fury X, which comes with its own liquid-cooling unit, this arrangement resulted in a much smaller graphics card than usual. However, that's not really an option when you're using air cooling, so Asus' Strix Fury card sports the same Direct CU III cooler as the 390 and 390X cards, on a full-sized card. The only difference is a cut-out in the backplate behind the GPU. The Fury also has some seriously beefy specs, boasting 3,584 stream processors – more than the 390-series cards, but not as many as the 4,096 in the Radeon R9 Fury X.

In terms of performance, though, the Fury sits in the same limbo area as the vanilla GTX 980 – it's faster than most cards at 2,560 x 1,440, but not in a way that hits more frame rate targets than cheaper cards, and it doesn't quite have the power needed to play every one of our test games at 4K, unlike the Fury X and GeForce GTX 980 Ti. It's a powerful card, but not quite powerful enough to make the jump to solid 4K gaming, still only managing a minimum of 23fps in Crysis 3 at this resolution.

As with the other Asus cards on test, the Fury card was surprisingly quiet, even at full load, and it was also cooler and more power-efficient than the 390 cards. Its GPU temperature peaked at just 68°C at load (a 44°C delta T),



which is a superb result for such a powerful GPU, and is testament to Asus' cooling talents – unlike the 390-series cards, it wasn't too hot to touch after testing either. At full load, our test system drew 388W from the mains with the Fury card installed, which isn't far off the 381W consumed by a standard GTX 980 Ti card. That's a lot of watts, but you're also getting decent performance from the card – it's a much more efficient setup than the 390-series cards anyway. Costing £450 inc VAT, this Asus Fury card is a serious investment, and it's well built, powerful and more power-efficient than the 390-series cards. However, the extra cost doesn't quite put it in the different league required for smooth 4K gaming, and cheaper cards can handle 2,560 x 1,440 gaming with no trouble. If you want to make the leap from 2,560 x 1,440 to 4K, you'll need a Fury X or a GTX 980 Ti card. We're really impressed by Asus' Direct CU III cooler though – it's quiet at full load and it can even keep a Fury GPU in check.

BEN HARDWIDGE

ASUS STRIX RADEON R9 FURY DIRECT CU III 4GB

SPEED
34/40

VALUE
27/40

FEATURES
9/10

EFFICIENCY
4/10

OVERALL SCORE
74%



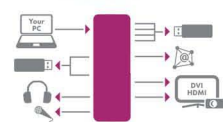
www.nanopoint.co.uk

Notebook Extensions for almost every Device...



ICY BOX IB-DK2651AC Multi Docking Station for Notebooks & PC

1x HDMI®, 1x DVI, 6x USB 3.0,
1x Gbit LAN, 1x 3.5 mm audio combo,
1x 5.1 channel surround sound



ICY BOX IB-DK2241AC Multi Docking Station for Notebooks & PC

2x USB 3.0 with charge function,
4x USB 2.0, 1x Gbit LAN, 1x HDMI®
and 1x DVI (Dual-Link), 1x Microphone
and 1x audio 3.5 mm jack, Inclusive
DVI to VGA adapter





GAMING KEYBOARD

Corsair Gaming Strafe / £100 inc VAT

SUPPLIER www.scan.co.uk / MODEL NUMBER CH-9000088-UK

Corsair Gaming's new Strafe is the first totally new design to come out of Corsair's peripheral arm for a few years, and it takes quite a different approach to features than the classic K-series keyboards.

For a start, while the plastic construction is solid, it's a far cry from the aluminium used in several of Corsair's previous efforts, including the K70 and K65. There are also no dedicated media controls – instead you use a combination of a function key and the F keys. That's a bit of a shame given the price – at £100, the Strafe is only a little cheaper than the venerable K70, which is still available at a few retailers and includes dedicated media controls, while the RGB version available for around £20 more.

Thankfully, the Strafe offers a couple of features that help it justify its price tag. The backlighting is fully programmable and is per-key configurable, so you can illuminate specific sets of keys depending on the game you're playing. Using Corsair's Utility Engine (CUE), you're able to apply some pretty fancy lighting effects and reassign every key as well. The software itself is still a tad complex compared to other suites we've used recently, however, such as the software with the Labs-winning CM Storm Trigger-Z.

The backlighting is crisp and punchy, but it does have a slight pinkish hue, especially at the brightest two of the three light levels – you can toggle through the levels using a dedicated button above the numeric keypad. The lighting also extends to strips running down the side of the chassis,

which match the brightness level of the keys as well. You can turn off the lighting too, but the lowest setting is quite appealing both in daylight and in a dark room if you don't want the glare of full brightness all the time. You can create macros with the CUE software as well, although sadly the Strafe lacks any dedicated macro keys.

Our sample's keys all used Cherry MX Red switches, which had the usual light, linear feel that's great for games, with responsive, quick and accurate keystrokes. However, if you want a higher actuation force or more feedback, you'll

need to look at keyboards with Cherry MX Black, Blue or Brown switches and, sadly, the Strafe only comes in Red or Brown flavours. On the plus side, you can replace any of the QWERTF keycaps with the supplied textured caps, which help to anchor your fingers to the right key-sets in games through tactile feedback.

Finally, a feature that's been absent from many Corsair Gaming keyboards is a USB pass-through port – the K70 RGB, for example, lacks one. However, it returns with the Strafe and is located to the right of the main cable. Sadly, it's only USB 2 and not USB 3, but it's still useful for connecting a mouse or headset. The cable itself isn't braided but it's heavy-duty and stretches to a handy 1.8m.

Conclusion

The Strafe is a solid effort from Corsair Gaming. Its programmable, per-key lighting and replacement keycaps are great, and it's good to see the USB pass-through port return too. However, its plastic casing and lack of dedicated media controls are disappointing when compared with the aluminium K70, as are its lack of macro keys. The Strafe is a decent gaming keyboard, but this is a crowded market and Corsair is capable of doing better.

ANTONY LEATHER

/SPECIFICATIONS

Connection Wired, USB
Cable 1.8m, non-braided
Materials Plastic
USB ports Yes
Backlighting Red
Switch type Cherry MX Red
Extras Cherry MX Key puller, replacement tactile QWERTF keys

DESIGN
34/40

FEATURES
29/30

VALUE
19/25

OVERALL SCORE
82%

VERDICT

A solid keyboard for Cherry MX Red and Brown users, although the lack of macro keys and media controls put it up against some stiff competition.

Performance without compromise



Trion 960

- Overclocked Intel® Core™ i5-4690K
- ASUS® Z97-P
- 8GB HyperX FURY RAM
- 2GB NVIDIA® GeForce® GTX 960
- 120GB Kingston V300 SSD
- 1TB Hard Drive
- Windows 8.1
- 3 Year Standard Warranty

THIS SPEC FROM

£649*



Vanquish HAF III

- Intel® Core™ i5-4590
- ASUS® H81-Gamer
- 8GB HyperX FURY RAM
- 2GB NVIDIA® GeForce® GTX 960
- 120GB Kingston SSD
- 1TB Hard Drive
- Windows 8.1
- 3 Year Standard Warranty

THIS SPEC FROM

£749*



Minerva

- Intel® Core™ i5-4690K
- ASUS® RoG MAXIMUS VII RANGER
- 16GB HyperX FURY RAM
- 4GB NVIDIA® GeForce® GTX 970
- 120GB Kingston HyperX 3K SSD
- 2TB Hard Drive
- Windows 8.1
- 3 Years Warranty

THIS SPEC FROM

£999*



Ultimate Ti

- Intel® Core™ i7-5930K
- ASUS® Rampage V Extreme
- 32GB HyperX PREDATOR RAM
- 6GB NVIDIA® GeForce™ GTX980Ti
- 6GB NVIDIA® GeForce™ GTX980Ti
- 240GB HyperX SAVAGE SSD
- 1TB Western Digital Black Hard Drive
- Windows 8.1
- 3 Years Warranty

THIS SPEC FROM

£2,999*



Optimus Nebula

- Intel® Core™ i7-4720HQ
- 15.6" Matte Full HD IPS LED
- 8GB HyperX IMPACT RAM
- 2GB NVIDIA® GeForce® GTX 960M
- 120GB Kingston HyperX 3K SSD
- 1TB Hard Drive
- Windows 8.1
- 3 Year Standard Warranty

THIS SPEC FROM

£849*



Defiance 17

- Intel® Core™ i7-4720HQ
- 17.3" Matte Full HD LED Screen
- 16GB HyperX IMPACT RAM
- 4GB NVIDIA® GeForce® GTX 980M
- 240GB Kingston SSD
- 1TB Hard Drive
- Windows 8.1
- 3 Year Standard Warranty

THIS SPEC FROM

£1,349*

Order your system now with PC Specialist



/pcspecialist

@pcspecialist

Some features require Windows 8.1. Update available through Windows Store. Internet access required; fees may apply. Microsoft, and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

* Prices are including VAT and are correct at the time of printing, but subject to change.



Award winning custom PC & Laptop manufacturer

Unleash the gamer within you



Vulcan 440

- Overclocked Intel® Core™ i7-4790K
- ASUS® Maximus VII Ranger
- 16GB HyperX FURY RAM
- 4GB NVIDIA® GeForce® GTX 980
- 500GB Samsung EVO 850 SSD
- 2TB Hard Drive
- Windows 8.1
- 3 Year Standard Warranty

THIS SPEC
FROM

£1,499*

Quality builds at a low price
Always

GET A FURTHER £15 OFF WITH THIS EXCLUSIVE VOUCHER CODE:

CPC15

ORDER ONLINE NOW

0333 011 7000

www.pcspecialist.co.uk

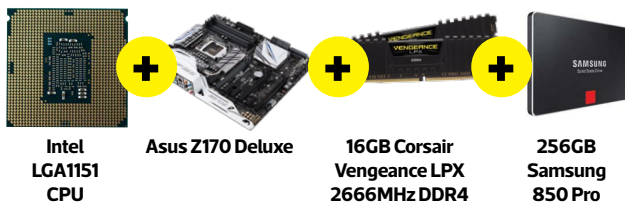
How we test

Thorough testing and research is the key to evaluating whether a product is worth buying, and deciding whether or not there's a better alternative

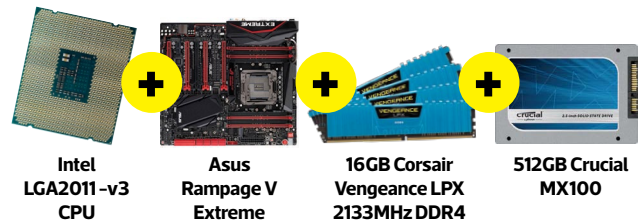
PROCESSORS

We judge CPUs on whether they offer sufficient speed for the price. Part of a CPU's speed score comes from how overclockable it is. Every type of CPU is tested in the same PC, so all results are directly comparable.

INTEL LGA1151



INTEL LGA2011-V3



AMD FM2+



COMMON COMPONENTS

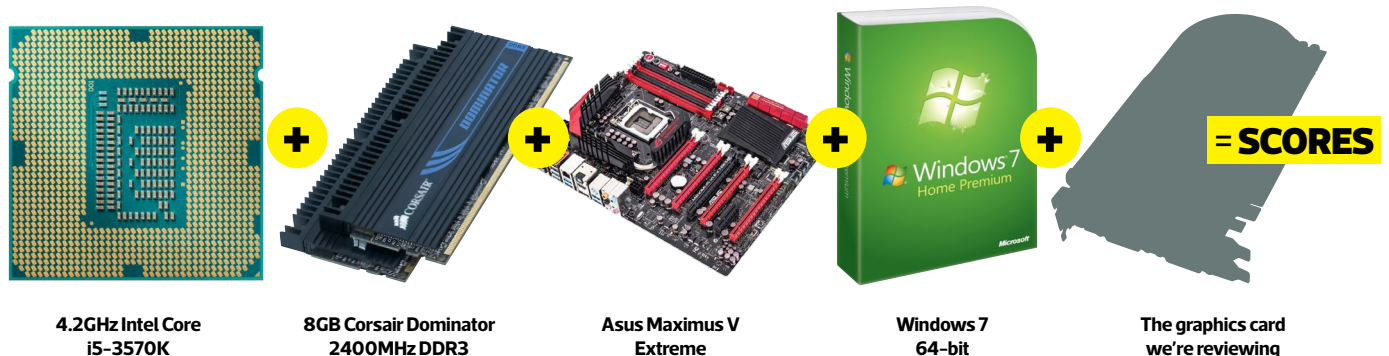


TESTS: We use Custom PC RealBench 2015, Cinebench R11.5 and a variety of games. We also test the power draw of the test PC with the CPU installed. These tests reveal a broad range of performance characteristics, from image editing to gaming and video encoding to 3D rendering. We run all tests at stock speed and again when overclocked to its highest frequency.

*Please note: We test AMD FM2+ APUs using the on-board graphics, not the Nvidia GeForce GTX 780 3GB

GRAPHICS CARDS

Graphics cards are mainly evaluated on how fast they are for their price. However, we also consider the efficacy and quietness of the cooler. Every graphics card is tested in the same PC, so all results are directly comparable.



CUSTOM PC REALBENCH 2015

INTEL REFERENCE



Intel Core i7-4790K
16GB of Corsair 2400MHz DDR3
240GB OCZ 150
Asus Maximus Gene VII
Nvidia GeForce GTX 780 3GB

AMD REFERENCE



AMD A10-7850K
8GB of Corsair 2133MHz DDR3
256GB Plextor M5 Pro
Asus A88X-Pro

Our benchmark suite, co-developed with Asus, simulates how people really use PCs – a higher score is better. You can download them from www.asus.com/campaign/Realbench

MOTHERBOARDS

Motherboards are evaluated on everything from layout and features to overclockability and value for money. Every motherboard is tested with the same components, so all results are directly comparable.

INTEL LGA1151



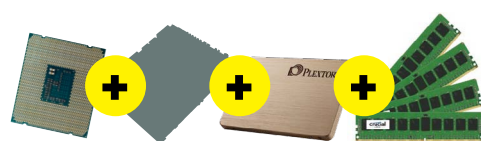
Intel Core i7-6700K
Motherboard on test
16GB Corsair Vengeance LPX 2666MHz DDR4
256GB Samsung 850 Pro

AMD FM2+



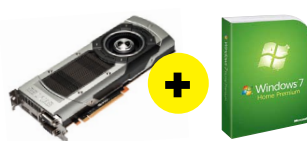
AMD A10-7870K
Motherboard on test
16GB Corsair Vengeance Pro 2133MHz DDR3

INTEL LGA2011-V3



Intel Core i7-5960X
Motherboard on test
Plextor M6 256GB
32GB Crucial 2133MHz DDR4

COMMON COMPONENTS



Nvidia GeForce GTX 780 3GB*
Windows 7 64-bit

TESTS: We use Custom PC RealBench 2015 and several games, and also test the speeds of the board's SATA ports. We try to overclock every motherboard we review by testing for a maximum QPI, base clock or HTT as well as overclocking the CPU to its maximum air-cooled level. We run our tests at stock speed and with the CPU overclocked.

*Please note: We test AMD FM2+ motherboards using the on-board graphics, not the Nvidia GeForce GTX 780 3GB

The Awards



EXTREME ULTRA

Some products are gloriously over the top. These items of excellent overclock earn our Extreme Ultra award.



PREMIUM GRADE

Premium Grade products are utterly desirable – we'd eat nothing but beans until we could afford them.



PROFESSIONAL

Products worthy of the Professional award make you and your business appear even more awesome.



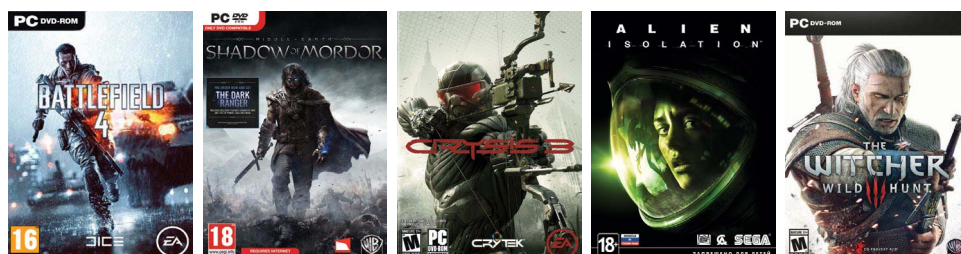
APPROVED

Approved products are those that do a great job for the money; they're the canny purchase for a great PC.



CUSTOM KIT

For those gadgets and gizmos that really impress us, or that we can't live without, there's the Custom Kit award.



TESTS: By using the fast PC detailed on the left, we can be sure that any limitations are due to the graphics card on test, rather than being CPU limited. We test Battlefield 4, Shadow of Mordor, Crysis 3, Alien: Isolation and The Witcher 3: Wild Hunt at their maximum detail settings, in their highest DirectX mode, at several resolutions. High-end cards should be able to sustain playable frame rates at 2,560 x 1,440, while 1,920 x 1,080 is more important for mid-range cards; we also test at 3,840 x 2,160 for 4K monitors, and try to overclock every graphics card we test to assess the performance impact.

SUBSCRIBE NOW!



Subscribe to **Custom PC** today and save on the single issue price.

Each issue of *Custom PC* will be delivered directly to your device each month.

SEE NEXT PAGE FOR SET-UP INSTRUCTIONS

▶ HOW TO SUBSCRIBE...

...on an iPad or iPhone

- STEP 1** Return to the *Custom PC* library
- STEP 2** Choose your subscription term and tap twice on the 'price' box
- STEP 3** Choose whether to create an optional *PixelMags* account
- STEP 4** Enter your *Apple ID* password to confirm



...on a Kindle Fire

Kindle Fire subscriptions come with a **FREE** one month trial.

- STEP 1** Tap '**Free Trial Subscription**' in the *Custom PC* library
- STEP 2** Choose your subscription term from the drop down menu on the popup that appears
- STEP 3** Tap '**Subscribe**'



...on an Android device

- STEP 1** Open the Google Play Store *homepage* and navigate to the *Newsstand* section using the tabs at the top
- STEP 2** Search for *Custom PC* using the search icon in the top right of the screen
- STEP 3** Click the '**Subscribe**' button and pick your term
- STEP 4** Enter your *Google* password to confirm



...via the Zinio app

- STEP 1** Search for *Custom PC* via the search box in the *Shop* tab
- STEP 2** Tap the '**Subscribe**' button
- STEP 3** Choose whether to create an optional *Zinio* account
- STEP 4** Enter your *Apple ID* password to confirm



**Subscribe to *Custom PC* today and
save on the single issue price**

Custom Kit

Paul Goodhead checks out the latest gadgets, gizmos and geek toys



CASE FAN

Antec TrueQuiet 120 UFO / **£13 inc VAT**

If you're thinking about blinging up your build, adding some Antec TrueQuiet 120 UFO fans to your rig will definitely add a touch of colour. Available in four colours (white, blue, green and red), the fans have a clear plastic ring on their intake side, which is illuminated by four LEDs.

The effect is pretty, if a little uneven, and the lights are powered from a 3-pin motherboard header, rather than needing a Molex connection. The fans proved quiet too, partly thanks to the huge marshmallowy

rubber grommets that cover each of the four mounting points. There's even a built-in speed switch that spins the fan at high or low speeds. You can't turn off the LEDs, which could be annoying in some situations, but the overall the effect is striking without being vulgar, and you get a good fan to boot.



SUPPLIER www.cclonline.com



USB CHARGER

Arctic SmartCharger 8000 / **£19 inc VAT**

Keeping all your devices charged can often feel like an incessant battle with a group of hungry, angry infants, especially if they're all waiting to use a single mains adaptor. You could install USB wall sockets (see opposite), but the Smart Charger 8000 is a neat option too. Sized like a hockey puck, it plugs into the wall (with a 1m cable) and provides five high-speed 2.9A charging ports – enough for any bedside table.

While the 2.9A output is impressive (and makes for very quick charging), the overall unit output maxes out at 8A, so connecting more than three devices will slow charging times overall. Still, it looks good, works well and is a great deal for £19 too – just what you need to satisfy all those hungry black rectangles.



SUPPLIER www.amazon.co.uk



USB WALL SOCKET

BG Nexus USB Socket / **£20 inc VAT**

Given USB's omnipresence, it seems silly to be using bulky adaptors to charge our devices from the wall. Hallelujah, then, that we're now seeing wall sockets with USB ports. At £20, the metal-faced BG Nexus costs several times the price of a non-USB socket, so you'll want to install them in key areas, rather than littering them all over the house. On the plus side, they come in several flashy finishes, including brushed metal and various colours, rather than just white plastic.

It's also annoying that the two ports share only 2.1A of output (so adding a second device reduces the charging speed of the first), but at least it's easy to fit, being the same shape and size as a normal 25mm plug socket fascia, and you wire it up in the same way too.



SUPPLIER www.builderdepot.co.uk

PHONE ACCESSORY

Cardboard Smartphone Projector / £16 inc VAT

Let's be clear – a few sheets of cardboard and a cheap lens won't magically turn your phone into a projector. If it sounds too good to be true, it probably is. Brightness is the main issue. Even the most modern smartphone screen simply isn't designed to push out enough light to project a sharp image over a useful distance. We could only move the unit about 30–50cm away from a wall before the image quality fell off a cliff. Below these distances, the image quality made movies watchable, but the projection was barely bigger than the screen itself.

It isn't entirely without merit though. It's fun and easy to assemble, and it would provide an interesting way to teach a child how a home projector or cinema screen works.

●●○○○

SUPPLIER www.firebox.com



HARD DRIVE DOCK

Icy Box IB-112STU3-B / £22 inc VAT

There's nothing flashy about this hard drive docking station. In fact, it's hard to imagine a more minimal design, but this simple SATA dock supports USB 3, so it's really quick. We measured read and write speeds of 85.9MB/sec and 102.4MB/sec respectively with an SSD.

Granted, you're more likely to use old hard disks with the caddy than SSDs, but it's great to know your transfer speeds won't be bottlenecked, and even mechanical hard drives are much quicker over USB 3 than USB 2. The reliance on an external PSU is an annoyance, but the 112STU3-B otherwise does its job fine and it isn't badly priced either.

●●●○○

SUPPLIER www.overclockers.co.uk



MUG

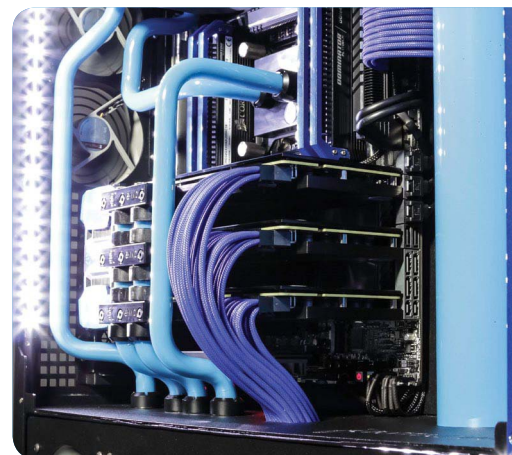
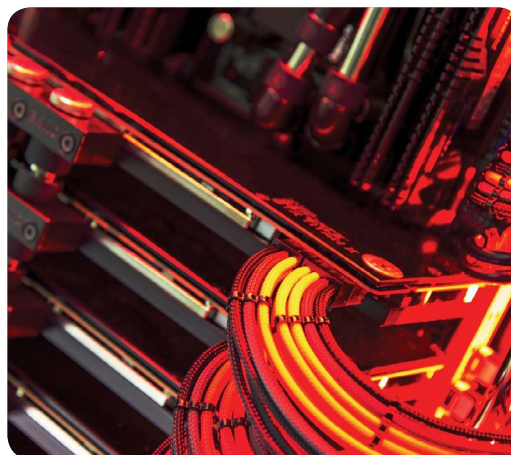
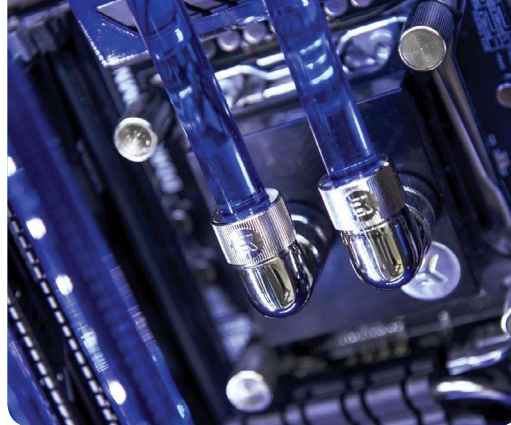
Warp Pipe Mug / £13 inc VAT

The Warp Pipe Mug fits firmly into the 'why has nobody thought of this before?' category. It's a fantastic product for any Mario fan, and it brought a smile to our faces every time we filled it up with a warming brew. The chunky angular handle looks great, and fits with the pixelated brickwork and pipe graphics, while the mug itself is sturdily made and safe to put in a dishwasher or microwave. In fact, all that's missing is an angry Piranha Plant, but you wouldn't want to get your face too near one of those things anyway. The price of £13 may be a little on the expensive side for a mug (even if it can double as a novelty plant pot), but it's just the ticket as a gift for a gaming-obsessed friend.

●●●○○

SUPPLIER www.firebox.com

Seen something worthy of appearing in Custom Kit? Send your suggestions to paul_goodhead@dennis.co.uk



LABS TEST

Custom PC Dream PCs 2015

Six of the most desirable PCs on the planet go head to head

Customisation, extreme hardware, epic performance and gorgeous looks are all what the next few pages of the magazine is all about. We've asked several of the UK's leading PC manufacturers to enter systems they consider worthy of being called Dream PCs – the ultimate gaming desktop rigs, with multiple graphics cards, intricate water-cooling systems and extensive modding.

In a new take on our usual Dream PC format, to cater for different budgets and to entice some more system builders to join the fun, we have two price tiers this year. We start proceedings at a modest, but still lavish price limit of £6,000, with three systems entering this

group from Scan, Overclockers UK and Chillblast. We then have the true extreme machines, which hover around the £10,000 mark.

Here, multi-Dream PC award-winner Scan is joined by two new and very dishy competitors from Dino PC and Overclockers UK. There's a total of seven GTX Titan X cards, and three GTX 980 Ti cards in the top tier alone, so if you're lucky enough to be able to splurge some serious cash on a gaming PC, or like any good enthusiast, you just want to see the amazing feats of PC building you can build for this kind of cash, this month's Dream PC Labs test is sure to be a treat.

ANTONY LEATHER

Featured this issue

High end Dream PCs

Chillblast Arkham Knight Dream Edition / p41

Overclockers Infin8 Emperor / p44

Scan 3XS Cyclone / p48

Ultimate Dream PCs

Dino PC T. Rex / p52

Overclockers 8Pack Supernova / p55

Scan 3XS Barracuda / p58

Results graphs / p61

Chillblast Arkham Knight Dream Edition / £4,999 inc VAT

SUPPLIER www.chillblast.com

The Arkham Knight Dream Edition isn't Chillblast's first Dream PC entry and after joining the contest a few years ago, it's had time to get to know what it takes to aim for the top spot. It's consistently improved its entries too, and this year looks set to be its best yet in terms of customisation. The Arkham Knight Dream Edition is a rare addition to the Dream PC line-up as it has a completely custom case – one of only a few examples in the history of the competition.

Of course, regular readers might recognise the design and materials – it's made by Parvum Systems and is a limited-edition, stretched version of its S2.0 case specially made for Chillblast. Called the Batman: Arkham Knight Armour, the case sports white LEDs, an in-set Batman logo, elongated chassis with custom details and enough room for a considerably more elaborate water-cooling system than a standard S2.0 case. Chillblast has fitted an XSPC AX240 double 120mm-fan radiator in the front section and an EX360 triple

120mm-fan radiator in the roof. Despite being smaller than Scan's 3XS Cyclone, the Arkham Knight Dream Edition actually boasts more cooling capacity.

Dealing with the heat are five Corsair SP120 fans, which Chillblast has coloured yellow to match the distinctive colour scheme. There's some juicy-looking yellow Mayhems Pastel coolant too, which is clearly visible in both the clear tubing and XSPC's gorgeous DDC Photon 170 tube reservoir. This reservoir is equipped with a Laing DDC pump, which is smaller than the Laing D5 pumps used in many of the larger systems this month, so it's ideal for the smallest PC on test too.

The choice of tubing is interesting at this price too, and acrylic tubing may have looked more attractive, but it can also look a little odd in small cases, where it can be a nightmare to work with too. Besides, the Chillblast's setup still looks striking and will be easier to maintain than an acrylic tubing setup too.

Meanwhile, there's an XSPC RayStorm CPU waterblock and EK waterblocks for each of the Nvidia GeForce GTX 980 Ti cards, which are connected in series using an EK FC Terminal fitting, which sits at the side of the waterblocks. There are numerous other elements of customisation too. The SLI bridge sports a yellow Nvidia logo, Chillblast



has also painted the motherboard heatsinks and the company has used custom-braided yellow and black cables as well. In addition, Chillblast has added dust filters to the case, which aren't included with Parvum cases as standard.

The hardware is just as varied in this cheaper group of PCs as it is in their pricier siblings. The Arkham Knight Dream Edition retails for just under five grand, so it's a little short of our £6,000 target, but so are both of the other PCs on test. Thankfully, Chillblast hasn't dropped down to a Core i7-5930K and has gone all out with a Core i7-5960X, although it's only been overclocked to 4.2GHz – a fair bit slower than the other PCs on test. However, it does sport an additional two physical CPU cores (and two logical ones) compared to the Cyclone and it means Chillblast doesn't have to speed-bin CPUs either.

As the case is micro-ATX-only, Chillblast had a limited choice when it came to X99-based motherboards, because there's only a handful available compared to the swathes of full-sized ATX models around. It chose the same board we would have chosen though – Gigabyte's GA-X99M-Gaming 5. While it lacks the full complement of DIMM slots, the board still offers quad-channel memory support across its four slots, and Chillblast has opted for 32GB of 2666MHz Corsair Vengeance DDR4 memory.

Meanwhile, a pair of GeForce GTX 980 Ti cards deal with frame rates, although sadly, they aren't overclocked. This is a shame, as other manufacturers have proved there's plenty of headroom and extra performance to be had, especially as Chillblast has water-cooled the cards.

With the graphics cards taking up most of the expansion slot spaces, Chillblast was left with the option of using the M.2 port and SATA 6Gbps ports for the Arkham Knight Dream Edition's storage, and it's wisely used both, making a great choice with Samsung's epic SM951 NVMe SSD. This 512GB beast can dish out data at over 2GB/sec and write it at

/SPECIFICATIONS

CPU Intel Core i7-5960X
overclocked to 4.2GHz

Motherboard Gigabyte
GA-X99M-Gaming 5

Memory 32GB 2666MHz
Corsair Vengeance DDR4

Graphics 2x Nvidia GeForce
GTX 980 Ti 6GB

Storage 512GB Samsung
SM951 M.2 SSD, 4TB Seagate
Hybrid hard disk

Case Custom Parvum

Cooling XSPC RayStorm CPU
waterblock, XSPC DDC Photon
170 reservoir and pump, EXPS
EX360 triple 120mm-fan
radiator, XSPC AX240 double
120mm-fan radiator, XSPC and
EK fittings, clear tubing, yellow
Mayhems Pastel coolant, 5x
Corsair SP120 fans.

PSU Corsair AX1200i

Ports Front: None; Rear: 8x
USB 3, 1x Gigabit Ethernet,
1x optical S/PDIF, 2x PS/2,
6x audio

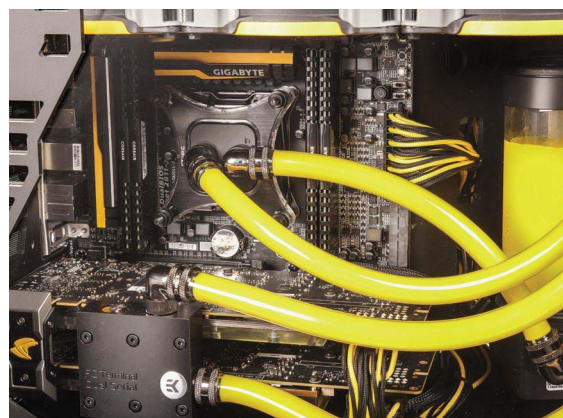
Operating system Windows 8.1
64-bit

Warranty Two years collect and
return parts and labour, plus
three years return to base
labour only



over 1.5GB/sec, making it a formidable solid state drive, especially compared with SATA equivalents.

To round off a decent storage setup, Chillblast has thrown in a Seagate 4TB hybrid drive too, which is fine in terms of capacity, and makes for a more well-rounded storage setup than the Scan Cyclone, which has just 480GB of storage, albeit extremely fast storage. However, the OcUK Emperor nails the storage system in this category, with its 512GB M.2 primary SSD, secondary 512GB Samsung 850 Evo SSD and 3TB hard drive.



Finally, the PSU of choice is a Corsair AX1200i with custom-braided cables, which has more than enough to deal with the Arkham Knight Dream Edition's peak power draw of 762W. Chillblast's warranty extends to five years of free labour, with the first two years covering parts with a collect and return service.

Performance

With a modest CPU overclock and no GPU tweaking, the Arkham Knight Dream Edition was at a disadvantage when it came to our benchmarks. In the 2D tests, though, it wasn't in last place, thanks Chillblast opting for an 8-core CPU, which, despite its frequency disadvantage, still made the Arkham Knight considerably faster than the Cyclone. It managed a Cinebench R15 score of 1,630 compared to the Cyclone's 1,333, a Terragen result that was a massive 30 seconds quicker and it had a 19 per cent score advantage in RealBench 2015 suite too.

The Cyclone did manage a decent score in image editing, thanks to this test being lightly threaded, but the Arkham Knight Dream Edition was faster in all the multi-threaded tests. However, the Infin8 Emperor's higher overclock saw it claim the vast majority of the 2D tests and the 300MHz clock speed advantage, as well as some expert tweaking, saw it pull out a significant lead over the Arkham Knight Dream Edition. It was a further 23 seconds quicker in the Terragen test and 19 per cent quicker in the RealBench overall.

In the game tests, the Arkham Knight Dream Edition's modest overclocking was also pretty evident, as it came last in all but one test, and it was also the only PC on test to fail to meet our borderline playable minimum frame rate of 25fps





- 1** A gorgeous DDC Photon 170 tube reservoir shows off the yellow coolant
- 2** The two GTX 980 Ti cards are water-cooled but not overclocked
- 3** The custom Parvum chassis is a limited-edition, stretched version of the S2.0

in GTA V at 4K. Its minimum frame rate in Battlefield 4 was also a good 7fps lower than the nearest competitor, and its 51fps minimum in Crysis 3 was 3fps behind the next competitor too. The latter two results are still perfectly respectable, of course, but you expect more performance from a machine at this price, particularly when you have so much cooling power available. Likewise, there was also a big difference in Unigine Valley, with Infin8 Emperor scoring 3,959 compared to the Chillblast's 3,218.

Thankfully, the CPU overclock did result in the coolest CPU on test, with a temperature of just 83°C under load equating to a delta T of 57°C, while the Infin8 Emperor and Cyclone had delta Ts of 60°C and 64°C respectively. However, the Arkham Knight Dream Edition's GPUs were a tad warmer at 55°C (with the same ambient temperature), a result that's 7°C warmer than the GPUs in the Cyclone. Part of the reason for this difference is likely the low noise – the Chillblast was exceptionally quiet, implying there would be less airflow in its chassis.

Conclusion

Despite having mediocre overclocking and gaming performance, the Arkham Knight Dream Edition turned quite a few heads in our lab thanks to its unique case and striking interior. In fact, it was one of the most striking-looking PCs to grace our lab this month and for a dream PC, this factor can be just as important as speed or hardware. Its chassis and

customisation are far more original than the customised Corsair case used by Scan. If you want a PC to stand out then the Arkham Knight Dream Edition is a great choice.

The case is well made and, while it's custom-built, it has few of the drawbacks of other cases of this type we've seen in the Dream PC Labs in the past, such as lack of dust filters or poor finishing. It's a little trickier to work with this case, as the construction demands the use of numerous screws rather than two thumbscrews and a side panel, but that's part of the charm of Parvum cases anyway.

The comparatively slower performance in games is an issue at this price, though, and the speed score is where it loses most of its marks, especially against the Overclockers UK Infin8 Emperor. However, Chillblast should pat itself on the back for its great effort with the chassis, as well as making good choices with the CPU and storage.

ANTONY LEATHER

SPEED
18/25
HARDWARE
21/25

DESIGN
31/35
VALUE
10/15

OVERALL SCORE
80%

VERDICT

A great-looking PC with good storage, a powerful 8-core CPU and a cracking custom Parvum case, although it's let down by mediocre overclocking and slightly disappointing gaming performance.

Overclockers UK Infin8 Emperor / £5,399 inc VAT

SUPPLIER www.overclockers.co.uk

Like the other PCs on test in this category, the Infin8 Emperor undercuts our £6,000 price limit by quite a margin at £5,399, but it's still the most expensive system on test, being £400 more than the Chillblast Arkham Knight Dream Edition and £1,400 more than the Scan 3XS Cyclone. However, as we're sure you'll agree, on looks alone, the Infin8 Emperor looks worth the money.

It's a stunning-looking PC, with a menacing blue glow catching the front fan grille, and its footprint is smaller than the gargantuan 8Pack Supernova (see p55), so it has a more manageable, compact feel. The case itself is Lian Li's PC-D600 – a large cube case used for workstations, but Overclockers UK has modified it to improve cable routing and sprayed its new panels black to match the interior – similar to Scan's efforts. The exterior doesn't feature much customisation, other than the installation of

an Aqua Computer Aquaero fan controller, although the aforementioned ominous blue glow from the interior lights really looks great.

A large side window gives a great view of the gorgeous interior, while keeping within the decidedly understated look of the case. The inside aesthetics are among the best on test of any PC this year, largely thanks to the compartmentalised layout of the case, which enables the pump and cables to be hidden away on the far side behind the motherboard. However, the PSU has had to be mounted in full view, so Overclockers UK had no choice but to add sleeving to the entire length of cables using Pexon Paracord, although it's also sprayed the PSU housing itself to match the colour scheme.

Numerous other parts have had a lick of paint too, including the GPU waterblock backplates and motherboard heatsinks. Blue, black and chrome are essentially all the colours left, and it's a potent combination. The cooling system is epic too, with a massive Coolgate triple 140mm-fan radiator in the motherboard chamber, and a further triple 120mm-fan radiator in the rear chamber using Noiseblocker fans. Like the other PCs in this tier, the Infin8 uses a single water-cooling loop, powered by a Laing D5 pump with an EK top in the rear chamber, along with a large, clear tube reservoir.

The tubing is also clear, and Overclockers has added Mayhems dye to the clear coolant to give it its distinctive blue hue. What really makes the system, though, is the Monsoon acrylic tubing. Overclockers UK has been busy with its heatgun this month, bending tubing for both its PCs, but it's really gone to town with the Infin8 Emperor, which is the only PC to include it in the lower tier.

Meanwhile, the CPU and GPU waterblocks are all made by EK, with the latter installed in a parallel cooling arrangement, linked by two connectors, rather than the single connector used in the Cyclone. Although the Cyclone and Emperor's GPU cooling systems are similarly effective, the parallel arrangement looks better to our eyes.

The hardware is a key issue among the cheaper PCs, which don't have the luxury of going all out with their



/SPECIFICATIONS

CPU Intel Core i7-5960X
overclocked to 4.5GHz

Motherboard Asus X99 Deluxe

Memory 16GB 2666MHz
Corsair Dominator Platinum
DDR4

Graphics 2 x Nvidia GeForce
GTX 980 Ti 6GB

Storage 512GB Samsung
SM951 SSD, 512GB Samsung
850 Evo, 3TB Hard disk

Case Lian Li PC-D600

Cooling EK Supremacy Evo
CPU waterblock, 2 x EK FC titan
X waterblocks, EK D5 pump
and top, EK reservoir, Coolgate
triple 140mm-fan radiator,
Coolgate triple 120mm-fan
radiator, Noiseblocker e-Loop
fans, Mayhems coolant, EK
fittings, Monsoon clear
acrylic tubing

PSU Superflower 1600W

Ports Front: 4 x USB 3; Rear:
8 x USB 3, 2 x USB 2, 2 x Gigabit
Ethernet, 1 x optical S/PDIF,
6 x audio

Operating system Windows 8.1
64-bit

Warranty Two years collect and
return parts and labour, plus
three years return to base
labour only





1
Blue, black and chrome are essentially the only colours, and it's a potent combination

2
The Emperor is the only PC in the sub-£6,000 category to include acrylic tubing

3
The epic cooling system includes a huge Coolgate triple 140mm-fan radiator in the motherboard chamber

components. First up is the CPU and, unlike the cheaper Scan, Overclockers UK has made the leap to a Core i7-5960X, which sports two more cores and four more threads than the Cyclone's Core i7-5930K. It's a shrewd move, and the Infin8 Emperor has a 4.5GHz clock frequency too, with plenty of tweaking going on in the EFI by 8Pack, who dealt with our system.

The choice of GPUs was a given at this price – two GTX 980 Ti cards make perfect sense and thankfully Overclockers UK had overclocked them too, unlike Chillblast, with a GPU core of a fantastic core clock of 1350MHz and a 1900MHz memory frequency. The Super Flower 1,600W PSU is perhaps a little overzealous for a PC of this calibre,

with the Infin8 Emperor only drawing 786W under full load, but at least you can add a third GPU at some point without worrying about not having enough power.

Like Scan, Overclockers UK has chosen Asus' X99 Deluxe motherboard; as we mentioned earlier, this has been painted to look the part and the system includes 16GB of 3000MHz Kingston HyperX DDR4 memory as well. The board has plenty of storage options, but Overclockers has decided on a Samsung SM951M.2 SSD, which is much quicker than a standard SATA drive, but also has over 100GB more capacity than the 400GB Intel 750 used by Scan.

In addition, Overclockers UK has also installed a 500GB Samsung 850 Evo along with a 3TB hard disk. It might only



amount to £200 or so of gear but the extra storage makes the Infin8 Emperor a much better-rounded PC than the Cyclone storage-wise. At the very least, you'll be able to install GTA V without worrying about running out of storage space. It's a better setup than Chillblast's Arkham Knight Dream Edition too – it has the same SSD, but the Chillblast's hybrid hard disk won't be as fast as the Infin8 Emperor's Samsung 850 Evo, which is a handy place to dump those occasionally played games, but still see them load quickly.

Performance

We expected the Infin8 Emperor to be quick in our 2D tests but the combination of an 8-core CPU and hefty overclock proved to be a devastating force in our benchmarks. It put the Scan's 6-core CPU to shame in every single one of our multi-threaded tests, with the Cyclone only regaining some face in the lightly-threaded tests such as the image editing portion of our RealBench 2015 benchmark suite.

It was much quicker in Cinebench R15 too, and it completed our Terragen 3 rendering test nearly a minute quicker. Likewise, there was nearly 130,000-point difference in our heavily multi-threaded video encoding test, with the system score and Intel reference scores of 217,966 and 190 per cent wiping the floor with the Cyclone's 174,413 and 152 per cent.

Meanwhile, the game tests limited the advantage of extra CPU core, so the rest of the system could come into play.

Here, it was tit for tat with very small margins between the Scan and Overclockers UK systems. Battlefield 4 preferred the Infin8 Emperor, although only by 2fps on the minimum frame rate and 7fps on the average frame rate, while the Cyclone was a couple of frames per second ahead in the other three games, most likely due to the higher CPU core frequency. The benefit of overclocked graphics cards was clear, though, with the Chillblast's GTX 980s struggling to keep up in most of the game tests.



Cooling-wise, the Infin8 Emperor's water-cooling system also allowed for one of the coolest Core i7-5960Xs on test, with a 5°C difference in the delta T compared to the Cyclone, and its GPUs were 3°C cooler too. Noise-wise, the Infin8 Emperor was also quieter than its sister system, the 8Pack Supernova, but again, Scan had an edge when it came to decibels, although not by much – we'd be happy to sit next to both PCs for long gaming sessions.

Conclusion

The Overclockers UK Infin8 Emperor is a good example of hitting the nail on the head. The 8-core CPU offers loads of multi-threaded performance, and

Overclockers has also applied a decent overclock. The GPUs are spot on and help to keep the price below six grand compared with using two GTX Titan X cards, and the interior is absolutely epic.

The storage setup really makes a difference too and is better rounded than that of both other PCs in this group. All that's missing is some fancy external customisation. Turn off the lights and remove the Aquaero fan controller and the case would look pretty normal, although the Lian Li PC-D600 does have a rather imposing presence. That said, Scan only added a custom front panel, while Chillblast used a customised Parvum design. Even so, the Infin8 Emperor still looks fantastic thanks to the blue glow coming through the front grille.

The Infin8 Emperor might be the priciest PC in this category, but Overclockers has spent its budget wisely and come up with a fast, cool, quiet and smart-looking setup with a carefully chosen specification, making it a clear winner if you're looking for a sub-£6,000 high-end PC.

ANTONY LEATHER



SPEED
23/25
HARDWARE
23/25

DESIGN
31/35
VALUE
10/15

OVERALL SCORE
87%

VERDICT

The great-looking Infin8 Emperor suffers none of the issues of Scan and Chillblast's PCs, boasting great storage, overclocks and across-the-board brilliant performance.



ND4000

- Intel i7 4790K OC @ 4 x 4.6 GHZ
- Corsair Vengeance 8GB 1600 MHZ
- 240GB SSD
- Corsair H80i Liquid Cooling
- Gigabyte Z97P-D3 (Intel Z97)
- NVIDIA GeForce GTX 970 - 4 GB
- NZXT Source 340
- Corsair 750W Modular PSU
- Windows 7 Home Premium - 64 BIT
- 2 Year Collect & Return Warranty
- Express Pre 12 Next Day Delivery

£999

**Pay4
Later**
Finance Available



ND3000

- Intel i5 4690K OC @ 4 x 4.6 GHZ
- Corsair Vengeance 8GB 1600 MHZ
- 1 TB SATA-III HDD
- Gigabyte Z97P-D3 (Intel Z97)
- AMD Radeon R9 380 - 4 GB
- Corsair 100R Gaming Case
- Corsair 650W PSU
- Windows 7 Home Premium - 64 BIT
- 24x Dual Layer DVD Reader/Writer
- 2 Year Collect & Return Warranty
- Express Pre 12 Next Day Delivery

£750

**Pay4
Later**
Finance Available

Customise @ www.computerplanet.co.uk/custom-pc/



DESIGN
YOUR
OWN PC



PRE
DESIGNED
CUSTOM PCs



NEXT DAY
DELIVERY
PCS



CUSTOM
LAPTOPS

facebook

twitter

01925 873 400

CUSTOM PC READERS ENTER PROMO CODE **CPM05** FOR SPECIAL DISCOUNT

Scan 3XS Cyclone / £3,999 inc VAT

SUPPLIER www.scan.co.uk

As we now have two tiers in our Dream PC Labs, Scan (like Overclockers) has entered two rigs, with the sub-£4,000 3XS Cyclone being the cheapest system on test. As usual, though, the Cyclone is highly configurable on Scan's website, so if any of the hardware here doesn't take your fancy you can opt for a different setup.

Unfortunately, a couple of quite critical corners have been cut to get the price down. Scan has opted for a Core i7-5930K CPU, with six physical cores whereas all the other PCs on test use the 8-core Core i7-5960X, which gives the Cyclone a disadvantage in multi-threaded benchmarks. Thankfully, though, the Cyclone has the joint highest CPU overclock on test, with a frequency of 4.625GHz, so it still has an edge in tests where clock frequency is king.

The other slight gripe we have with this PC is that it only has 400GB of storage, which is really the bare minimum if you're a heavy gamer – GTA V alone takes up more than 10 per cent of this space. The storage in question does come from a lightning-fast Intel 750 SSD, which blasts through reading and writing

data at 2.2GB/sec and 900MB/sec respectively, but both the other PCs in this category include similarly speedy storage and manage to include additional space too. This brings us to the price again – for another £800 or so, it could still be the cheapest PC on test, but could boost its specification massively with a Core i7-5960X and a 1TB Samsung 850 Pro for extra storage, for example.

Thankfully, the rest of the hardware is very competitive. Scan has included two EVGA GTX 980 Ti cards in SLI, which unlike the Chillblast system have been overclocked, so they should be able to stand up to the Infin8 Emperor in games. The GPU core stands at a whopping 1240MHz – a sizeable boost over the default 1126MHz, while the memory runs an effective frequency of 7.5GHz compared to the usual 7GHz. Scan has also installed 16GB of 2666MHz Corsair Dominator Platinum DDR4 memory, which is slower than the Infin8 Emperor's 3000MHz and it has slightly slacker timings too, although it's still more than fast enough for most people.

Both the Overclockers and Scan systems use the same motherboard – Asus' X99 Deluxe, which is one of our favourites, so we

have no complaints here. Unlike Overclockers, Scan hasn't needed to paint its board, as the heatsinks already match the white and black colour scheme of the Cyclone. There's a good deal of customisation going on too. Scan has added two new powder-coated plates behind the motherboard to tidy up and hide the cables, and it's added some white detailing to the EVGA SLI bridge too.

Meanwhile, the internal hard disk cages have been removed and a plate installed to cover the gaps for a smooth finish, while the massive reservoir at the front has been secured using custom mounts. The front of the case obviously looks very different to a standard Corsair Obsidian 750D too, thanks to the custom aluminium panel that covers the entire section. This part features cut-outs for the front panel ports, as well as Scan's logos, and it clips into the existing panel mounts, so it's easy to remove if you want to access the case's dust filters. If white isn't your colour of choice, Scan can also apply different colours to the case, as well as different coloured coolant.

The cooling system certainly isn't going to struggle with the hardware. There's a massive Alphacool XT45 triple 140mm-fan radiator in the roof, which frees up the rest of the case for other water-cooling gear and hardware. However, we'd have liked to see Corsair's SP140 fans used here instead of the AF140s, as the former have a higher static pressure and are better suited to use with radiators. Scan has chosen an EK Supremacy Evo CPU waterblock to cool its Core i7-5930K, and EK FC Titan X waterblocks for each of the GTX 980 Ti cards, which are connected in series



/SPECIFICATIONS

CPU Intel Core i7-5930K
overclocked to 4.625GHz

Motherboard Asus X99 Deluxe

Memory 16GB 2666MHz
Corsair Dominator Platinum
DDR4

Graphics 2 x EVGA Nvidia
GeForce GTX 980 Ti 6GB

Storage 400GB Intel 750 SSD

Case Corsair Obsidian 750D

Cooling EK Supremacy Evo
CPU waterblock, 2 x EK FC Titan
X waterblocks, EK D5 pump, EK
X3 reservoir, Alphacool
NexXos XT45 triple
140mm-fan radiator, 3 x Corsair
AF140 fans, Mayhems Pastel
coolant, Bitspower fittings, EK
ZMT black tubing

PSU Corsair HX850i

Ports Front: 2 x USB 2, 2 x USB
3; Rear: 8 x USB 3, 2 x USB 2, 2 x
Gigabit Ethernet, 1 x optical S/
PDIF, 6 x audio

Operating system Windows 8.1
64-bit

Warranty Three years parts
and labour, with one year on
site and two years collect and
return

using a single piece of tubing rather than one of EK's FC connectors.

Meanwhile, the coolant is off-the-shelf White Pastel by Mayhems, and it runs through EK ZMT black tubing, which has a rubbery feel and look. It's obviously cheaper to use than acrylic tubing and fits in with the colour scheme of the Cyclone, but in terms of aesthetics, it's not as high-scoring as the acrylic tubing in the Infin8 Emperor.

Overall, the Cyclone is clean-looking, and it's flashier than your average water-cooled system, but it looks rather plain compared with the gorgeous Infin8 Emperor, and it doesn't have the striking, unique appearance of Chillblast's custom Parvum system. By spending more cash, OcUK and Chillblast have added a bit more pizzazz to the equation. That said, the Cyclone is a great-looking system for the sub-£4,000 asking price.

There's a great warranty that covers a full three years of parts and labour, with the first year getting full on-site coverage too.

Performance

As we suspected, the Cyclone's 6-core CPU didn't fare too well against the 8-core monsters in the other two PCs in this group. It was well behind in Cinebench and Terragen 3, where even the modestly overclocked Chillblast Arkham Knight Dream Edition managed to significantly outperform it. Sporting a similar overclock, but four additional CPU threads, the Infin8 Emperor was in a different league performance-wise and was much faster in Cinebench,



1

Two new powder-coated plates behind the motherboard help to hide cables

2

A massive Alphacool XT45 triple 140mm-fan radiator sits in the roof

3

The EK ZMT black tubing has a rubbery feel and appearance

while knocking nearly a minute off the Cyclone's five-minute render time in Terragen 3.

The Cyclone's extra clock did see it obtain the best image editing score in this category in RealBench 2015, but overall the Cyclone languished in a distant third place. It posted a system score of 174,413 compared to the Chillblast's 196,114 for Chillblast and a massive 217,966 for Overclockers UK, with the latter boasting a 38 per cent advantage in the Intel reference score.

Thankfully, multi-threaded performance isn't as important in game tests, where the Cyclone's additional CPU frequency and overclocked GTX 980 Ti cards came into play. It managed the top results in GTA V, Crysis 3 and The Witcher 3, although rarely by more than 1-2 fps, and in the latter test, both the other systems managed a higher average frame rate too. The Infin8 Emperor was king in Battlefield 4, but again the difference was only a couple of frames per second. However, the Arkham Knight Dream Edition was noticeably slower, especially in Battlefield 4 and Crysis 3, where the Cyclone's more potent overclocks made themselves known.



Scan's overclocking and cooling arrangement did lead to the highest CPU temperature on test of 90°C though – 5°C warmer than the nearest competition, even after accounting for ambient temperature fluctuations. The Infin8 Emperor's GPUs were a little cooler too, but thankfully the Cyclone is very quiet, even under load. Meanwhile, it drew over 760W from the wall – pushing its 850W PSU hard.

Conclusion

While Scan has gone for value with the Cyclone, which managed to offer big overlocks, customisation, speedy storage and two GTX 980 Ti cards in SLI for four grand, value for money isn't much of a concern in a Dream PC test. More importantly, it could still be the cheapest Dream PC on test by making two simple changes that would have largely

solved its poor 2D benchmark scores and our two main criticisms – the CPU and storage. The Core i7-5930K is fast, and Scan's overclock was great, but it's no match for a similarly overclocked Core i7-5960X.

The storage is an issue, though, as 400GB isn't really enough space for any hardcore gamer that also might want to store other software, music, videos and other paraphernalia on their PC – even PCs costing half this amount usually have more storage, even if it's just a hard disk. The Intel 750 SSD might offer some of the fastest storage around, but a more balanced approach was needed here. The hardware issues

could have been easily solved too. For less than £1,000, it could have added an 8-core CPU to the fray and boosted the storage with a 1TB Samsung SSD, and the PC would still be cheaper than both the other PCs on test.

Customisation was certainly on show with the cyclone, although the choice of case meant it didn't look quite as lavish and striking as the Overclockers UK Infin8 Emperor or Chillblast Arkham Knight Dream Edition. Thankfully, in games at least, the Cyclone was quick and usually represented much better value than the other systems in terms of bang per buck.

The Cyclone is a good-looking, well-built system for the money and, to be fair, you can configure its specification too. However, in the world of Dream PCs, it's up against some stiff competition, with both OcUK and Chillblast offering more interesting-looking systems with better hardware. In this category, Overclockers' Infin8 Emperor deserves the top spot for its epic looks, amazing performance across the board and an excellent storage setup, which are all worth the extra outlay.

ANTHONY LEATHER



SPEED
20/25
HARDWARE
19/25

DESIGN
29/35
VALUE
12/15

OVERALL SCORE
80%

VERDICT

A good-looking, well-built PC with decent overlocks and a tempting price, but in this league it's let down by a 6-core CPU and insufficient storage.

BUILD YOUR VICTORY



BUILD YOUR VICTORY

The Nyth comes equipped with massive out-of-box configuration options, with 36.738 combinations via its 33 modular buttons, plus a variety of side-grip options to maximize gamer comfort and control. The first fully integrated 3D printable gaming mouse, the Nyth is your unique fingerprint in gaming. Configure Nyth to any PC gaming genre. MOBA, FPS and more - the Nyth is your

custom gaming tool. Twin-Tech Laser Sensor R1 with up to 12000dpi, 2-level multicolor illumination with 16.8 million colors available, the 2D Titan Wheel, ROCCAT® Swarm support, a dedicated Easy-Shift[+] key, support for ROCCAT Talk®/AlienFX™ and loads more. Future Ready means being prepared for it all.

GET OUT THERE AND WIN



MODULAR MMO
GAMING MOUSE

MORE INFORMATION
WWW.ROCCAT.ORG/NYTH

Dino PC T. Rex / £9,999 inc VAT

SUPPLIER www.dinopc.com

While Scan is an old hand when it comes to Dream PCs, we have some highly capable newcomers this year in the form of Overclockers UK and Dino PC. The latter has acquired a particular PC builder who has worked at several high-profile manufacturers, such as Beast Computers and Vadim in the past, and this year, Dino PC makes a spectacular entrance to our Dream PC Labs test with the aptly named T. Rex.

The first feature that struck us when Dino PC delivered its massive PC to our lab was the exterior. Dino PC has covered it in a scale-patterned black vinyl. This finish may sound tacky if you haven't seen it in the flesh, but it looks fantastic. The vinyl is a mixture of matt scales and gloss black; thankfully, the effect is fairly subtle, and it does an excellent job of breaking up the

otherwise boxy outline of the Corsair 900D case. The vinyl has been expertly applied too, with no fraying edges or squished corners – we can only imagine how much time and effort went into this part alone. The end result is a PC that's unique, good-looking and wouldn't look out of place in an expensive fashion boutique.

The T. Rex has been modified in a similar way to the Scan Barracuda, with a custom-made horizontal plate that hides all the cables beneath it in the case's bottom half. Unlike Scan, though, Dino PC has gone one step further and used a completely illuminated plate that's lit from beneath. The bottom of the case is illuminated too, courtesy of a mirrored base that lights the Corsair 900D to look like something out of Fast and Furious. The result is one of the best-looking interiors of any PC this month. In terms of hardware, there's the popular Asus Rampage V Extreme sitting at the heart of the PC, which has been partly obscured by a massive yet gorgeous-looking EK full-cover waterblock that cools the CPU and several other hotspots on the motherboard all in one go.

The CPU is, of course, a Core i7-5960X, which has been overclocked to 4.6GHz. Dino PC has chosen some nifty RAM too – rather than opting for a 32GB kit, it's gone for a fast, 3200MHz 16GB Corsair Dominator Platinum kit, which also sports some of the tightest timings on test too. There's a sensible Corsair AX1500i 1500W PSU too, which will provide

plenty of headroom, and Dino PC takes the rare move this month of including a Blu-ray drive too.

The all-important GPU selection is different to that of Scan and Overclockers UK in this group as well. Dino PC has decided to go for a three-way SLI setup like the Barracuda, but has taken Overclockers UK's stance that only the fastest GPU will do and used three Nvidia GeForce GTX Titan X cards, which have been overclocked to 1142MHz on the core and 1878MHz on the memory. It's an interesting move, as it may have an edge on the Scan's GTX 980 Ti setup in games, but the machine also managed to hit our £10K price point bang on, so it's noticeably less wallet-smashing than the Supernova.

While the system looks fantastic and will eat 4K gaming for breakfast, it's the storage that really stands out with the



/SPECIFICATIONS

CPU Intel Core i7-5960X
overclocked to 4.6GHz

Motherboard Asus Rampage V
Extreme

Memory 16GB 3200MHz
Corsair Dominator Platinum
DDR4

Graphics 3 x Nvidia GeForce
GTX titan X 12GB

Storage 480GB Intel 750 SSD,
1TB Samsung 850 Pro, 2 x 6TB
WD Caviar Red in RAID 1, LG
WH14NS40 Blu-ray drive

Case Custom Corsair Obsidian
900D

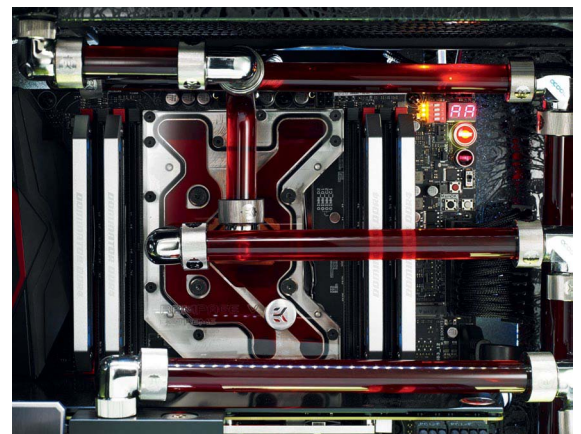
Cooling EK RVE full cover CPU
waterblock, 3 x EK FC Titan X
blocks, 2 x EK D5 pumps, 2 x EK
reservoirs, 2 x EK GTX quad
120mm-fan radiators,
Mayhems blood red Aurora 2
coolant, Monsoon Hardline
tubing, EK-ACF compression
fittings, 11 x Noiseblocker
NB-eLoop fans, Lamptron
CW615 fan controller,
Bitspower fill port, Phobya ball
valve drain ports

PSU Corsair AX1500i

Ports Front: 2 x USB 3, 4 x USB
2; Rear: 10 x USB 3, 2 x
USB 2, 1 x Gigabit Ethernet,
1 x optical S/PDIF, 1 x PS/2,
6 x audio

Operating system Windows 8.1
64-bit

Warranty Two years on site
parts and labour, plus one year
labour only return to base



T. Rex. There's a super-fast 480GB Intel 750 PCI-E SSD as the OS drive, which isn't quite as fast as the 1.2TB model in the Barracuda, but it still wipes the floor with SATA 6Gbps SSDs, and it likely has enough space for all your regularly used games and programs too.

The genius move, though, is to include a 1TB Samsung 850 Pro SSD as well, so if you need a little more space, you get more solid state storage space than with either the Supernova or Barracuda. If that wasn't enough, there are also two 6TB Western Digital Caviar Red hard disks in RAID 1 configuration, giving you a reliable and gargantuan data storage setup. It's easily the best storage setup on test and while you can configure the other PCs to include similar options, it's great to see this configuration supplied by default as a review system.

The cooling system is right up there with the best on test too. Dino PC chose two EK CoolStream XTX quad 120mm-fan radiators equipped with Noiseblocker NB-eLoop fans, which have been sprayed satin black, and there are two Laing D5 pumps connected to EK pump tops and reservoirs. The clear Monsoon acrylic tubing shows off the stunning Mayhems Aurora 2 coolant too, which has a fantastic swirling metallic effect.

Meanwhile, the tubing itself has been constructed mainly using straight lines and chrome EK fittings, rather than bending the tubing as Scan did with the Barracuda. However, the effect complements the luscious interior, so



1

The reptile scale-effect vinyl has been expertly applied and looks fantastic

2

The bottom of the case is illuminated, courtesy of a mirrored base

3

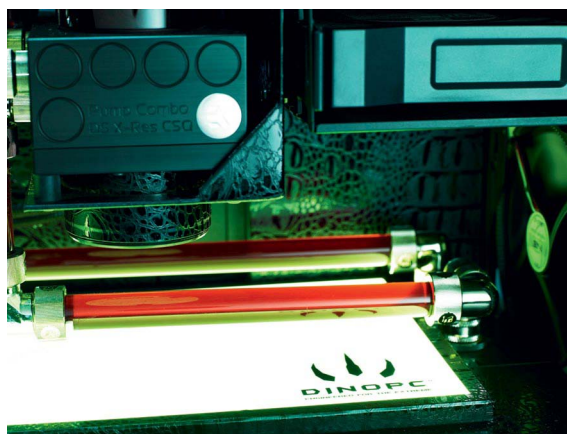
The Mayhems Aurora 2 coolant has a gorgeous swirling metallic effect

we'd probably have done the same too. Dino PC has also used an Asus ROG SLI bridge, which isn't customised like the one in the Barracuda, but it's illuminated and looks snazzier than the bare bridge in the Supernova.

All three GPUs are, of course, water-cooled and it's EK fittings all around again, with a trio of Titan X nickel waterblocks and an FC Parallel Bridge connecting the blocks together. Combined with some brilliant cable routing, the inside of the Dino PC is achingly attractive. Controlling the fans is a Lampttron CM615 touch-screen fan controller, which is very easy to use, so fine-tuning the T. Rex to your own needs is a simple process. There are a pair of ball valve drain ports too so, as with the Supernova, changing the coolant won't involve dismantling the whole cooling system.

Performance

With faster memory and a ROG motherboard compared with the Scan, it wasn't a surprise to see the T. Rex do battle with the Barracuda in our benchmarks, despite the latter's slight advantage in clock speed. In the 2D tests, the T. Rex



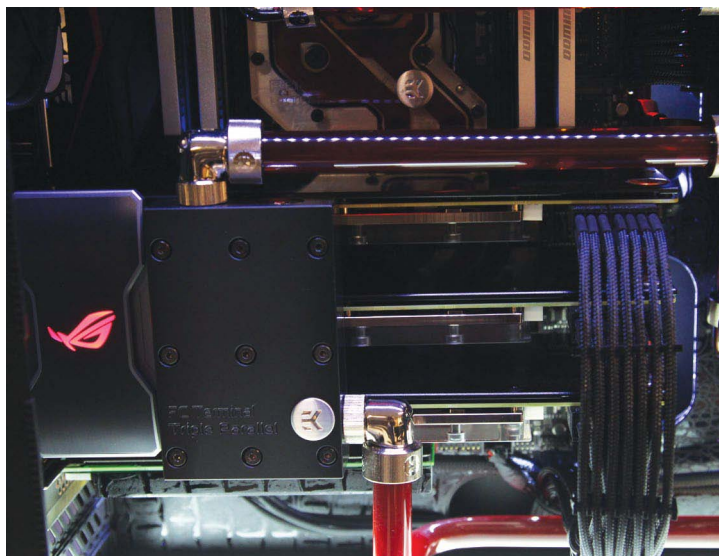
came out on top overall, being noticeably quicker in everything except the image editing test. The difference in Cinebench and Terragen 3 were smaller, but it was the Supernova that claimed most of the top spots.

Interestingly, Unigine Valley didn't seem to enjoy running on the Titan X setup as much as the 980 Ti system in the scan, recording a result slightly slower than the Supernova with its additional GPU. From here, though, it was tit for tat with the Barracuda. The T. Rex was faster in The Witcher 3, with 6 and 11 per cent quicker minimum and average frame rates respectively. Battlefield 4 and Crysis 3 were both claimed by the Barracuda – in all tests, the differences were marginal though. Again, the Supernova's extra GPU made it top dog in the game tests, but only by a small amount, with the exception of The Witcher 3, where the T. Rex toppled it.

The T. Rex proved to be quieter than the Supernova, but not as easy on the ears as the Barracuda. However, it did stick to its noise level, not really ramping up its fan speeds at all, which made it easy to forget about them. It also drew slightly more power – 1,115W compared to 1,086W for the Scan PC, but roughly matched the temperatures of the others PCs too.

Conclusion

Until we added up all the scores, we didn't know which PC would claim the top spot – each PC in this test is a cracking machine that has strengths in different areas. In the end, this difficulty was manifested in the final scores – there's just 3



per cent of a difference between first, second and third places, making this test one of the tightest Dream PC Labs ever. Overall, the T. Rex came second in terms of scores, but with just 1 per cent between it and the Barracuda, there are still reasons to buy the T. Rex, depending on your priorities.

The T. Rex is a beautiful PC, and the black scale vinyl does look really good. The interior is where all the action is at, though, and here, it's arguably on a par with the best systems on test this month. For anyone who might want to tweak and play with the cooling system, the T. Rex is arguably better than the Scan thanks to its fan controller and drain ports. We also have to tip our hats to Dino PC for the storage setup, where it made some excellent choices.

The choice of GPUs is, as usual, a tricky one. The Dino PC system has the kudos of being a Titan X-based PC with all the bragging rights that includes, although Scan's massively overclocked GTX 980 Ti cards have proved the better bet overall. While Dream PCs are all about no-limits specifications, there's no point spending extra money for little or no performance return. Otherwise, though, Dino PC has made a stunning first appearance in our Dream PC Labs test and will be a tough one to beat next time. In the meantime, if you can't afford the T. Rex, then Dino PC will be offering two smaller, cheaper systems under a new range called the Carnivore Series. Velociraptors anyone?

ANTONY LEATHER



SPEED
21/25

HARDWARE
22/25

DESIGN
31/35

VALUE
13/15

OVERALL SCORE

87%

VERDICT

Epic performance, a stunning interior and fantastic storage setup make the T. Rex a brilliant Dream PC. However, the trio of Titan Xs doesn't offer any benefit over the Scan's GTX 980 Ti setup.

Overclockers UK 8Pack Supernova / £11,499 inc VAT

SUPPLIER www.overclockers.co.uk

If you follow extreme overclocking, then 8Pack's name might be familiar to you. It's the online pseudonym of one of the UK's leading overclockers, who also happens to be the man behind most of the Overclockers UK's mega PCs. There's a wide range available, but to don the 8Pack name, a PC needs to have some serious high-end tweaking and hardware, and the 8Pack Supernova is no exception.

The case is a customised version of Lian Li's enormous cube workstation chassis from the company's PC-D600 series, which Overclockers UK asked the company to rebuild from the ground up so it could kit out the system with a mass of water-cooling gear, which we'll discuss in a minute. Needless to say, there's enough cooling power to deal with a small car engine, and the Supernova takes full advantage of it.

In true Dream PC fashion, there's no holding back here, and Overclockers has gone all out in the graphics department with four Nvidia GeForce GTX Titan X cards, all of which are water-cooled and overclocked. Both the GPU

cores and memory have been boosted by over 100MHz each, although not quite as far as the Titan Xs in the Dino PC T. Rex (see p52).

The choice of GPU was a talking point this month, mainly due to the GTX 980 Ti and Titan X performing fairly closely, but the latter costing a lot more. As such, it's a brave move by OcUK to claim the bragging rights as the fastest and most extreme Dream PC. By contrast, Dino PC opted for three Titan X cards, while Scan overclocked a trio of GTX 980 Ti cards instead.

As you would expect, OcUK has opted for Intel's flagship desktop CPU, the Core i7-5690X and 8Pack has personally overseen the overclocking on the system, applying some very extensive tweaking. In fact, the overclocking section of the EFI was littered with adjustments and included far more tweaks than either Scan or Dino PC's offerings. However, the actual CPU frequency matched that of Scan's Barracuda at 4.625GHz, which is a little faster than the T. Rex's 4.6GHz. There's a hefty 32GB of 2666MHz memory too – the same as the Barracuda, although the Supernova sports tighter timings, while Dino PC opted for less memory, but rated at a faster 3200MHz.

Sitting at the heart of the PC is an Asus Rampage V Extreme motherboard, which doesn't sport the lustworthy full-cover

waterblock used in the T. Rex, but OcUK has still water-cooled the VRMs and chipset, getting one over on Scan, which hasn't water-cooled the motherboard at all. Part of the reason for choosing separate blocks was perhaps to show off the chrome-plated copper tubing, which features a mix of handmade bends and straight-line connections.

EK waterblocks are used all round for the CPU, motherboard and graphics cards, split between two loops – one cooling the graphics cards and another dealing with the CPU and motherboard. Both loops sport their own Laing D5 pumps, with the CPU loop connected to a triple 120mm-fan half-height XSPC radiator, plus a double 120mm-fan full-height Coolgate radiator. Meanwhile, the GPU loop is cooled by a single triple 120mm-fan full-height Coolgate radiator. Unlike most of the other PCs on test, the Supernova includes coolant drain ports too, so if you fancy changing the colour of the coolant, you won't have to dismantle the cooling loop, which is a neat touch.

The numerous fans that cool the case and radiator are tied into an Aqua Computer Aquaero fan controller that can be programmed to offer near-silent noise levels when the Supernova is idle, while spinning up the fans under load to deal with heat.

Most of the action happens in one half of the enormous case, which is absolutely packed with gear, along with some expertly braided multicolour Pexon cables, which sport some great-looking cable combs too. On the far side of the case you'll find the rest of the hardware, which includes the storage and power supply. For the latter, Overclockers has opted for Super Flower's 2000W Platinum-rated model; this provides plenty of power, which is needed to supply the



/SPECIFICATIONS

CPU Intel Core i7-5690X
overclocked to 4.625GHz

Motherboard Asus Rampage V
Extreme

Memory 32GB 2666MHz
Kingston HyperX Predator
DDR4

Graphics 4 x Nvidia GeForce
GTX Titan X 12GB

Storage 2 x 1TB Samsung 850
Pro in RAID 0 configuration

Case Custom Lian Li PC-D600
series

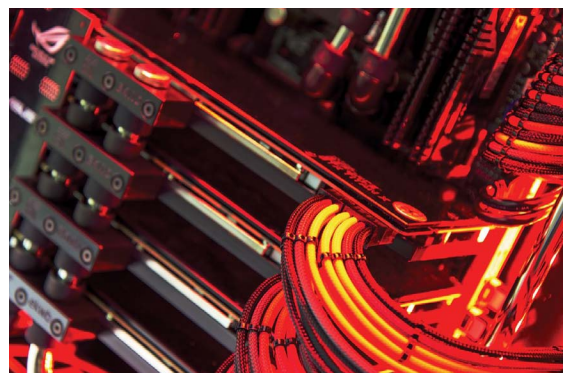
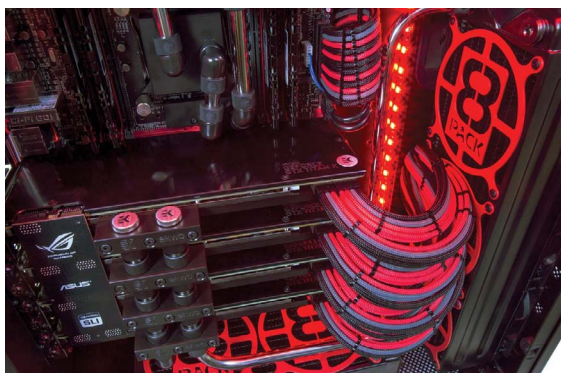
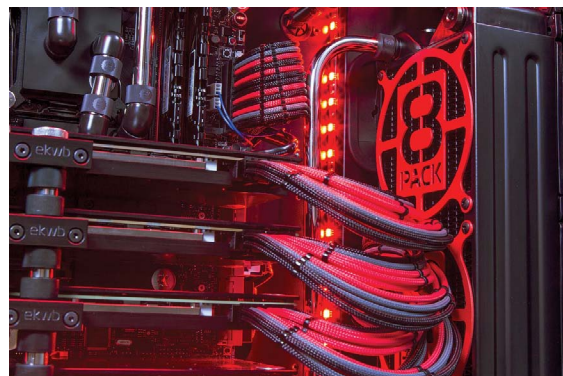
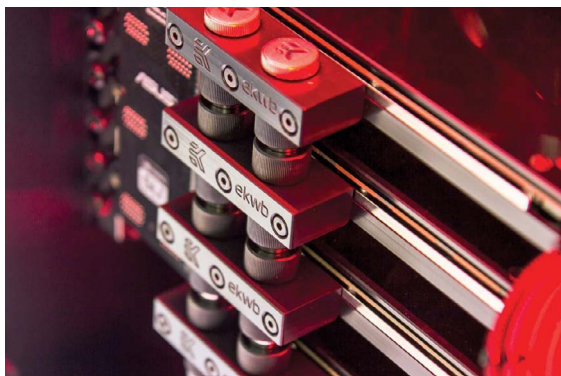
Cooling EK GPU and CPU
waterblocks, 1 x XSPC triple
120mm-fan half-height
radiator, 1 x Coolgate triple
120mm-fan full-height radiator,
1 x Coolgate double 120mm fan
full-height radiator,
Overclockers UK custom
SilverStone fans, EK fittings, 2 x
Laing D5 pumps, EK Reservoir,
chrome-plated copper tubing

PSU Super Flower 2000W

Ports Front: 4 x USB 3, 2 x
audio; Rear: 10 x USB 3, 2 x USB
2, 1 x Gigabit Ethernet, 1 x optical
S/PDIF, 1 x PS/2, 6 x audio

Operating System Windows 8.1
64-bit

Warranty Two years collect and
return parts and labour, plus
three years return to base
labour only



demands of the four graphics cards and the overclocked 8-core processor.

Storage-wise, the Supernova is solid, if not spectacular. We were a little disappointed not to see any next-gen PCI-E storage at this price – even the Supernova's cheaper sibling, the Emperor, offers an awesome Samsung SM591M.2 SSD, while both of its competitors use Intel's epically fast 750 Series SSD. It's not all bad news, though, as you get two 1TB Samsung 850 Pro SSDs in RAID 0, giving you a total of 2TB of fast flash-based storage, although it also comes with an element of risk – if one drive fails then you lose the whole lot. There's also a whopping 6TB of mechanical storage.

At first glance, the Supernova doesn't seem to offer a great deal of customisation, but it's easy to forget that the case isn't available off the shelf and has been custom made for the 8Pack series.

There's also an illuminated 8Pack logo, and once you push the power button, it comes alive with red lights that jazz up the already jaw-dropping interior.

One obvious customisation omission is the SLI 4-way connector – both Dino PC and Scan customised theirs and the Supernova's stands out as a little bland for this reason. Externally, there's not a whole lot going on either, but thankfully, the lighting comes to the rescue, bouncing off the front fan mesh to give a powerful,

but understated presence. It certainly isn't as flashy as the Scan Barracuda on the outside, but a flash exterior isn't everyone's cup of tea.

Many retailers have entered our Dream PC competition over the years, taking extreme pride in their work, and OcUK is no different. Either 8Pack himself, or another equally qualified OcUK system builder, delivers each PC personally and owners also get 8Pack's mobile number to call in case there are any problems. OcUK is more than happy to customise the specification to meet your needs as well.

Performance

We had to run our benchmarks on the Supernova a couple of times because we couldn't believe the system was so fast. Despite sporting similar overlocks to the Scan and

Dino PC systems, the Supernova's

expert tweaking meant it was consistently faster in our 2D tests. A small hiccup in the image editing test aside, the system score of 231,781 was over 10,000 points ahead of its nearest rival, and over 14,000 points ahead of Scan's Barracuda. The reference score of 202 per cent is the fastest we've seen here at **Custom PC** too, and is a cracking result.

The domination continued with a blistering score in Cinebench R15 too, although Scan's Barracuda clawed one test back with a result in Terragen that was 12



8Pack has personally overseen the overclocking, applying very extensive tweaking

seconds quicker. Moving on to our game tests, the situation was less clear overall. The move from three to four GPUs resulted in noticeable gains in most of our tests. For example, the average frame rate was nearly 30 per cent faster than the Barracuda in Crysis 3, while the minimum frame rate was around 6 per cent quicker. Our GTA V test saw some decent gains too; the minimum frame rate was 26 per cent quicker, although this only increased the average frame rate by 3fps.

The differences were smaller elsewhere though. Battlefield 4 only saw marginal gains over the Barracuda's three GTX 980 Ti cards, while The Witcher 3's had a 7 per cent boost to the average frame rate, but there was only 1fps difference in the all important minimum frame rate.

Another hiccup was Unigine Valley, where the Barracuda managed a much higher score than either of the Nvidia Titan X systems.

Meanwhile, the Supernova's SATA 6Gbps RAID array saw read and write speeds around 1000MB/sec, which was slower than the Intel 750 SSD's used in Dino PC and Scan's machines, but still not to be sniffed at. The cooling system kept the temperatures in check in our toasty lab, with the CPU peaking at 93°C – only a couple of degrees warmer than the others. OcUK had bumped up the fan cooling profile of the Supernova, so its fans were quite noticeable too, even at idle. By comparison, the Barracuda and T.Rex were much quieter and just as cool under load. Under full load, the system drew 1340W, so it was well within the limits of its 2000W power supply.

Conclusion

Overclockers UK delivered its system bang on time, with perfect stability (an achievement that's eluded many dream PCs in the past), despite the machine sporting a monster overclock and being the fastest overall system on test. In some cases, it was considerably faster than the competition too. It isn't as lavishly customised on the outside as the Barracuda, but the internals are spectacular.

There are a couple of downsides though. The fourth Titan X has a limited impact in some tests and it's questionable if the extra performance is worth the extra outlay, even in a Dream PC. Value isn't a major issue with Dream PCs, but even if money was no object, at **Custom PC** we'd still cast our critical eyes over such a purchase.

Other systems had better storage options too – we'd have preferred an M.2 or PCI-E SSD than a RAID array of SATA 6Gbps SSDs, but the extra 6TB of hard drive storage is welcome.

On the other hand, the Supernova is the fastest PC we've ever tested. If pure performance and hardware bragging



1

A stack of four Titan X cards gives the Supernova ultimate GPU bragging rights

2

EK waterblocks are used for the CPU, motherboard and graphics cards

3

Loads of red lights jazz up the already jaw-dropping interior

rights are your key priorities, then this mega PC is for you. Its understated looks betray the monster that lies within, and both the other similarly priced PCs struggled to keep up on occasions. Scan's Barracuda edges into first place in this test, thanks to more lustworthy customisation and storage, but only just.

ANTONY LEATHER

SPEED
24/25
HARDWARE
20/25

DESIGN
30/35
VALUE
12/15

OVERALL SCORE
86%

VERDICT

The fastest PC we've ever seen. Period. The competition sports better customisation, value and storage options, but for pure speed and hardware bragging rights, the Supernova simply can't be beaten.

Scan 3XS Barracuda / £9,499 inc VAT (including two-man setup)

SUPPLIER www.scan.co.uk

Scan needs no introduction when it comes to Dream PCs. Its systems are consistently brilliant, heavily customised and fast across the board. In fact, it's this consistency that often helps them have an edge over the competition overall, even if they lag behind in one or two areas. The 3SX Barracuda has some tough competition this year too, from Overclockers UK and Dino PC, although all three systems are quite different.

There's a mix of three and four-way SLI setups, a smattering of both Titan X and GTX 980 Ti cards, and storage plays a big part too, thanks to Intel's X99 chipset supporting a raft of new standards.

At face value, the Barracuda is, as you would expect, very good-looking. Most PC enthusiasts will recognise Scan's choice of case. The venerable SilverStone TJ07 makes its return, having been a popular choice in the past for Scan and other PC manufacturers. Scan's reasoning is that, despite a

good deal of research, no other case really took the team's fancy. It also has its current Dream PC sales to consider – like Overclockers UK, it sells a number of these behemoths each year and dishes out several TJ07-based systems. It's certainly still a great case, although Scan's use of it perhaps lacks the originality of Chillblast's decision to go completely new with a custom-made Parvum case.

That said, Scan hasn't just thrown a stock TJ07 at us. Unlike some of the PCs in this test, the Barracuda has been customised from head to toe. The case has received a new motherboard backplate to improve cable management, plus a horizontal plate that hides the lower half of the case, with both new panels being powder-coated black. It's perhaps less snazzy than the illuminated panel of the Dino PC T.Rex, but Scan's efforts don't stop there. It's also removed the internal drive cages and cut a grille in the roof, with both areas being filled and smoothed over before the application of its stunning metallic blue paint job.

Scan has also modified the profile of the main side window and added a rear panel window, providing a view of the three custom SSD mounts. Both windows have been made to mimic the sweeping curve of

the TJ07's front panel, rather than being totally square.

Meanwhile, the aforementioned custom grille in the roof extends the standard twin 120mm fan mount to fit a Magicool half-height triple 120mm-fan radiator. Externally, it looks like it's always been there, so Scan has certainly done a good job on this mod. All the original fans in the case have also been removed and replaced with Noctua fans, and seven NF-S12B Redux fans cool both the radiators, with the rear fans mounted externally as intakes to make way for the radiator in the roof.

This radiator cools the CPU, sporting its own Laing D5 pump and an EK Supremacy Evo waterblock. The

three GTX 980 Ti cards also have a loop to themselves, with a trio of EK FC Titan X waterblocks, a D5 pump and an EK Coolstream PE radiator in the base of the case. Each loop sports a massive EK Res X3 reservoir, both of which tower over the graphics cards in the front of the case.

Scan has also made a custom blue shade of Mayhems coolant that's visible in the reservoirs and clear Monsoon acrylic tubing. The tubing has been expertly bent to shape to pass through the custom horizontal plate at numerous locations, keeping the motherboard area clean and tidy. Cables have also been routed very well indeed as well, even if Scan didn't choose to use any cable combs, although the visible cables are extensions, so the whole cables aren't braided end to end.

Meanwhile, the Barracuda logo has been water-cut in order to deal with the detail required to create the fish's teeth, and both the internal and external logos are illuminated. There are a few additional details too, such as the painted SLI bridge and memory heatsinks, plus the USB 3 ports at the front, which Scan added itself. The custom painted SSD mounts behind the motherboard tray are vacant as standard but, should you want to add more SSDs, they'll look great through the side window.

The nitty gritty, hardware-wise, is perhaps the more interesting part of the Barracuda's makeup. It retails for just under our guide price of at least £10,000, but like the other two circa-£10K PCs, it uses Intel's Core i7-5960X, which has been overclocked to 4.625GHz. However, Scan has tinkered with fewer options in the Barracuda's EFI than Overclockers with the 8Pack Supernova.

There's also 32GB Corsair Dominator Platinum DDR4 memory, which runs at a relatively modest 2666MHz, although that's plenty fast enough.

Interestingly, Scan hasn't opted for the usual Asus Rampage V Extreme and has instead gone with Asus' X99-E WS motherboard, which ties in better with the colour scheme. As a result, the motherboard isn't water-cooled, so



/SPECIFICATIONS

CPU Intel Core i7-5960X
overclocked to 4.625GHz

Motherboard Asus X99-E WS

Memory 32GB 2666MHz
Corsair Dominator Platinum
DDR4

Graphics 3 x EVGA Nvidia
GeForce GTX 980 Ti 6GB

Storage 1.2TB Intel 750 SSD

Case Custom SilverStone TJ07

Cooling EK Supremacy Evo
CPU block, 3 x EK FC Titan X
blocks, 2 x EK D5 pumps, 2 x
EK Res X3 reservoirs, Magicool
half-height triple 120mm-fan
radiator, EK Coolstream PE 480
quad 120mm-fan radiator,
custom Mayhems Pastel
coolant, Monsoon Hardline
fittings, EK-ACF compression
fittings, 7 x Noctua NF-S12B
Redux fans

PSU Corsair 1200W HXi

Ports Front: 2 x USB 3; Rear: 10
x USB 3, 2 x Gigabit Ethernet, 1 x
optical S/PDIF, 6 x audio

Operating system Windows 8.1
64-bit

Warranty Three years parts
and labour, with one year
on site, and two years return
to base



it looks a little bare compared with a fully water-cooled machine such as the Dino PC T.Rex., but it still looks good.

Storage-wise, Scan has opted for a PCI-E 1.2TB Intel 750 SSD, so the Barracuda may not have the wow factor of the Supernova's four Titan X's, but it does have the fastest SSD we've ever tested. With over 1TB of storage sporting 2.4GB/sec read and 1.2GB/sec write speeds respectively, the Barracuda definitely trumps all the other PCs on test in this respect, and this SSD is absolutely the kind of hardware we

like to see in a Dream PC. That said, there's no additional storage, and with games such as GTA V consuming over 60GB alone, Dino PC's T. Rex offers the best balance of storage on test, with a smaller-capacity version of the Intel 750, plus a 1TB Samsung 850 Pro 1TB SSD and two 6GB hard disks.

As we've mentioned elsewhere, the choice of GPUs was a key factor in this year's Dream PC test, and Scan has taken the bold move of using three Nvidia GeForce GTX 980 Tis,



1

A trio of GTX 980 Ti cards is included, instead of pricier Titan X cards

2

An EK Coolstream PE 480 quad 120mm-fan radiator dominates the base

3

Each loop sports a massive EK Res X3 reservoir, towering at the front

each of which has been overclocked to 1240MHz on the core and 1853MHz on the memory. Its reasoning is that four cards aren't supported very well (even Nvidia is a little sketchy in recommending four over three cards in SLI) and the GTX 980 Ti, once overclocked, can perform close to Titan X speeds anyway. This setup, of course, enabled Scan to plough money elsewhere, as the graphics hardware costs substantially less than that of the other two PCs. All you lose, really, is the bragging rights of owning several Titan X cards.

Powering all this kit is a 1200W Corsair HXi – a testament to the power efficiency of Nvidia's latest graphics cards, as Scan feels comfortable offering a PSU with a rating that's lower than the load power consumption from some previous years' Dream PCs.

Scan offers a three-year parts and labour warranty, and each PC is hand-delivered and set up by two people. In addition, it's supplied with a custom-made desktop wallpaper and, in the unlikely event you should have an issue with the PC, it's pre-installed with a dedicated software application in the system tray that enables you to instantly report any issues direct to Scan. As with the other PCs on test, each Barracuda can be made to order both in terms of hardware and customisation as well.

Performance

Not surprisingly, the Barracuda was very fast in our tests, but it's up against some very stiff competition in this year's test.

It lagged a little behind the Supernova in all but two of the results. Overall, its system score in the Realbench suite was 217,126, with an Intel reference score of 189.71 per cent, while the Supernova managed 231,781 and 202 per cent. Also, while the Barracuda was faster in Unigine Valley, the real-world game tests saw it fail to nab any top spots, with the Supernova claiming most of the limelight. GTA V was the slowest result for the Barracuda, where the Supernova's additional graphics horsepower counted most.

However, the performance differences between Scan's effort and the other two PCs in this price range were marginal. Is the addition of a fourth card completely pointless? No, but it's arguably not worth the extra money when you could have a faster SSD instead.

The Barracuda's cooling system was also easily able to tame its hardware, and was the quietest system on test by a long way, even under load in our toasty lab. It had a peak power draw of 1,086W, although that was with the CPU and GPUs under full load, which is an unlikely everyday scenario.

Conclusion

Opting for three GTX 980 Ti cards, rather than a Titan X setup, was a rather risky move for Scan. Combined with slower 2D performance, the Barracuda was beaten in most of our benchmarks. It has the fastest storage here, but the T. Rex has a better overall storage configuration, while the Supernova claims the fastest dream PC crown.

The T. Rex also looks pretty good outside and inside, but once again, the bigger picture shows that the Barracuda is the best overall product. It's fast even if it isn't the fastest, its extensive customisation and paint job look fantastic, it has a solid hardware configuration and it offers decent value for money too, a combination that pips the other two PCs to the post. It isn't as fast as the Supernova, but it costs £2,000 less – that's a lot to pay for the extra speed offered by the Overclockers machine. All of this means the Barracuda wins this year's Dream PC labs, but by a slim margin.

ANTONY LEATHER

SPEED
19/25

HARDWARE
22/25

DESIGN
33/35

VALUE
14/15

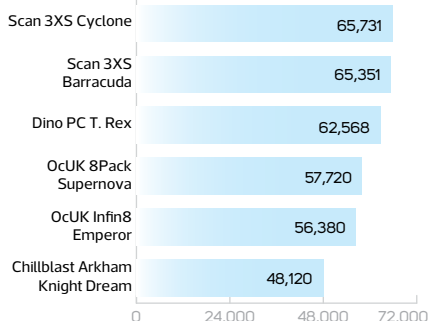
OVERALL SCORE
88%

VERDICT

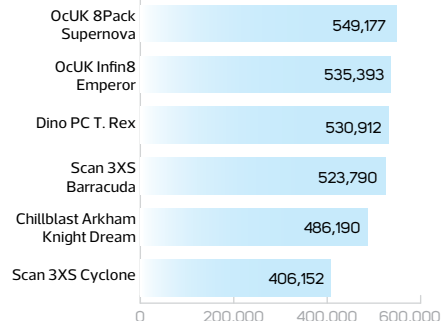
It isn't quite the fastest PC on test, but the Barracuda's super-fast SSD, solid specs, extensive customisation and great paint job just clinch it the top spot.

CUSTOM PC REALBENCH 2015

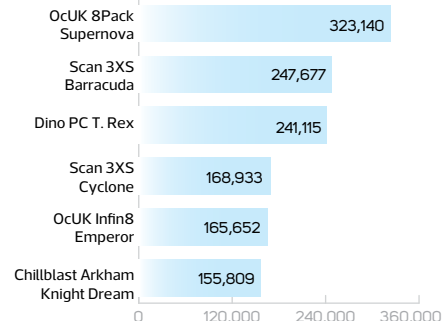
GIMP IMAGE EDITING



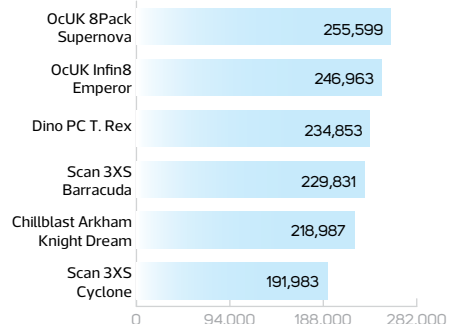
HANDBRAKE H.264 VIDEO ENCODING



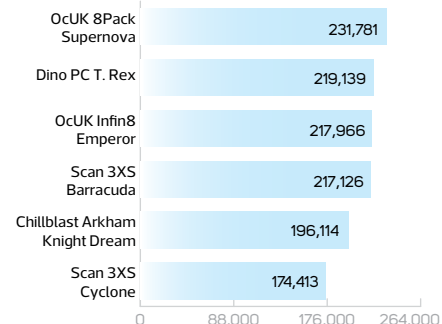
LUXMARK OPENCL



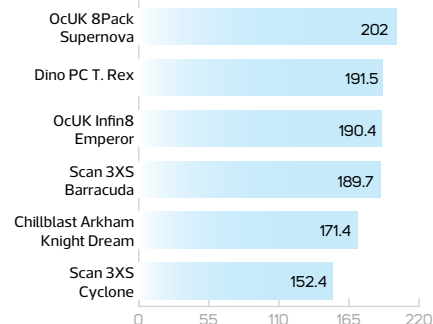
HEAVY MULTI-TASKING



SYSTEM SCORE

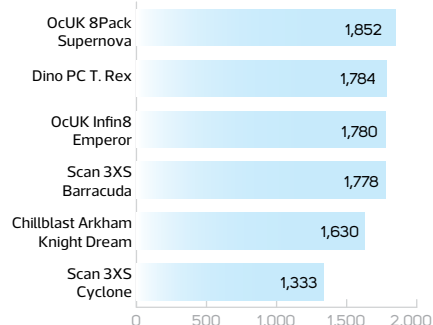


INTEL REFERENCE (%)

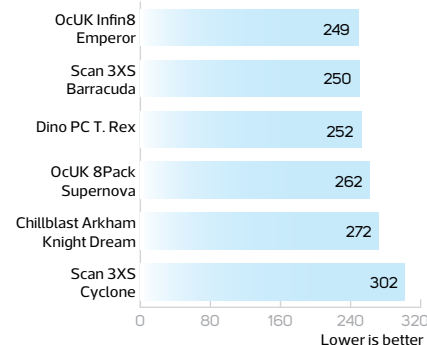


3D AND GAMES

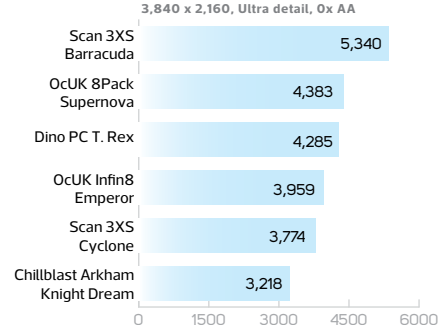
CINEBENCH



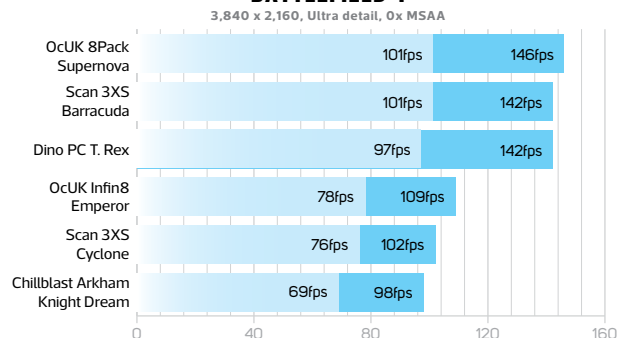
TERRAGEN (SECONDS)



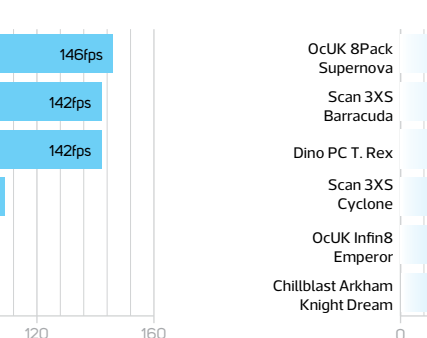
UNIGINE VALLEY



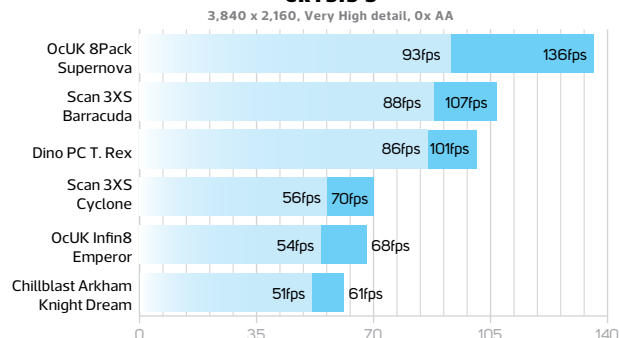
BATTLEFIELD 4



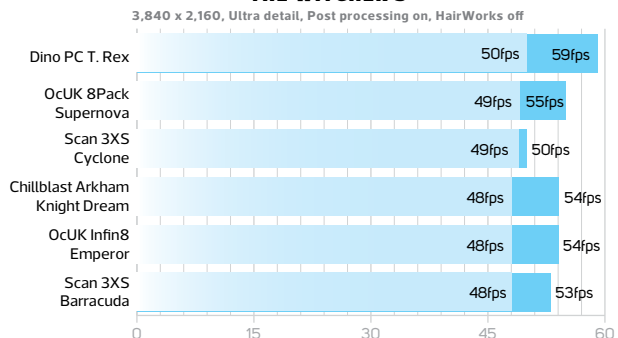
TERRAGEN (SECONDS)



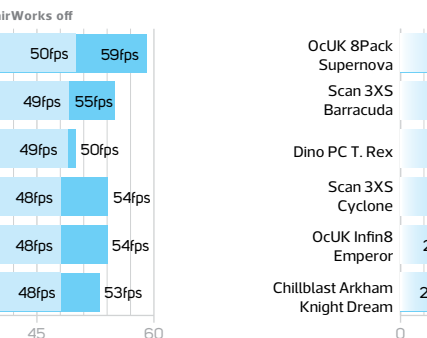
CRYSIS 3



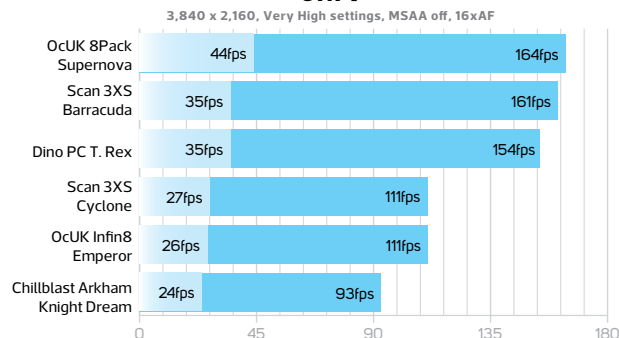
THE WITCHER 3



TERRAGEN (SECONDS)



GTA V



Minimum Average

PC system reviews

GAMING PC

CyberPower Infinity X3 SE / £499 inc VAT

SUPPLIER www.cyberpowersystem.co.uk

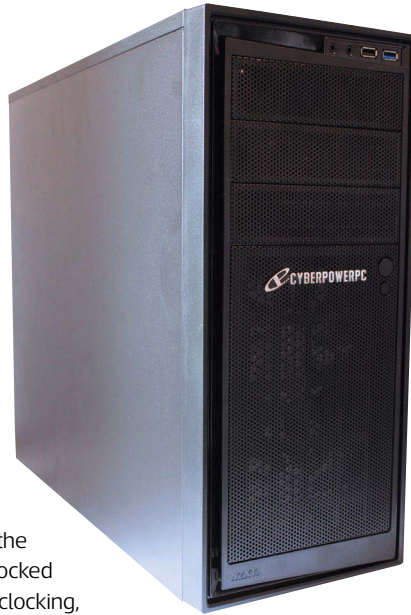
Most of the machines reviewed in **Custom PC** this month are ruinously expensive gaming beasts, but the Cyberpower Infinity X3 SE takes a different approach. Its £499 price makes it one of the cheapest desktops we've seen for months, but Cyberpower reckons it's still got the grunt to handle today's games.

Key to the CyberPower's ability to punch above its weight is the Intel Pentium G3258 – the Anniversary Edition chip released to celebrate the 20th birthday of the Pentium brand. It's the only low-end chip Intel sells with an unlocked multiplier, which means it's ripe for overclocking, potentially challenging chips that cost much more than its £52 asking price.

The Pentium uses the Haswell architecture and is clocked at 3.2GHz by default, but CyberPower has used a 1.375V vcore to get the chip running at 4.3GHz. That's the sort of jump we usually see on machines with overclocked Core i5 and Core i7 chips, so it's an impressive tweak. However, while you can expect the Pentium to perform above its price band, you can't expect it to match Core i7 silicon for performance, especially in multi-threaded scenarios. It has just two physical cores, without Hyper-Threading, along with 512KB of L2 cache and just 3MB of L3 cache.

Meanwhile, CyberPower has paired the Pentium with a Palit-made GeForce GTX 960. It's a solid choice for 1080p gaming, with 2GB of memory and its GPU overclocked from 1127MHz to 1165MHz. The £499 price means there's sadly no room for an SSD, but the 1TB hard disk is plenty for storage needs, and there's 8GB of memory too.

The budget really shows itself in the Gigabyte GA-H81-S2H micro-ATX motherboard though. It only has two DIMM slots, both of which are already full, and it can only handle a maximum of 16GB of 1600MHz memory. It also only has a single 1x PCI-E slot free at the bottom of the board, and just has two SATA 6Gbps connectors. Most of these issues stem from the use of the budget H81



chipset, which only allows for two memory slots, four SATA ports and a single 16x PCI-E 2 slot, with no support for PCI. Comparatively, a Z97 board would be a little pricier, but would also provide more upgrade potential for the future.

On the plus side, it's all housed in an NZXT Source 220, which is a decent mid-range tower. Its meshed front panel is smart and unfussy, and build quality is reasonable for the money too. The motherboard tray is small and doesn't stretch all of the way across the chassis, but CyberPower has done a reasonable job of keeping cables in check around

the front and rear. Impressively for the budget, you also get a Cooler Master Seidon liquid cooler, helping to keep the overclocked CPU cool.

The case also has loads of drive bays free, but they seem redundant when you consider the motherboard's SATA limitations. The micro-ATX board seems tiny in such a large tower – the NZXT enclosure feels a little wasted on a modest specification with so little room to grow.

Performance

The Pentium costs a fraction of some of Intel's high-end Core i7 chips, but CyberPower's overclock helped it to some impressive benchmark scores. Its image editing result of 56,650 is particularly good, as this mostly single-threaded test responds well to extra clock speed, and this result is only a few thousand points behind machines with overclocked Core i7 hardware. In other benchmarks, though, the Pentium's multi-threaded weaknesses were exposed, and the Intel reference score of 51.2 per cent shows the benefit of a Core i7-4790K in multi-threaded software.

But then no one expects a killer multi-threaded machine for £499. The big question is whether the Infinity X3 SE can deliver on its bargain-basement blaster promise. As expected, the GTX 960 proved itself a capable 1080p gaming card. Its Battlefield 4 minimum frame rate of 39fps is fine, and its Shadow of Mordor minimum of 52fps is only 8fps short of the magic 60fps figure. Its Crysis 3 minimum of 31fps is decent too. At 1080p, you can be confident that this machine won't dip below 30fps.

An increased resolution of 2,560 x 1,440 proved just beyond the GTX 960's abilities though. Its Shadow of

/SPECIFICATIONS

CPU 3.2GHz Intel Pentium Anniversary Edition G3258 overclocked to 4.3GHz

Motherboard Gigabyte GA-H81-S2H

Memory 8GB Kingston HyperX Fury 1600MHz DDR3

Graphics Palit GeForce GTX 960 2GB

Storage 1TB Seagate hard disk

Case NZXT Source 220

Cooling CPU: Cooler Master Seidon, 1x 120mm fan; GPU: 1x 70mm fan; Front: 2 x 120mm fans

PSU Cooler Master B500 500W

Ports Front: 1x USB 3, 1x USB 2, 2 x audio; Rear: 4 x USB 3, 2 x USB 2, 2 x PS/2, 3 x audio

Operating system Windows 8.1 64-bit

Warranty Two years parts and labour, plus one year labour only. First month collect and return, with return to base coverage afterwards.

- 1 **The small motherboard means there's lots of empty space in the big case**
- 2 **The Palit GeForce GTX 960 card handles 1080p gaming**
- 3 **The Cooler Master Seidon keeps the overclocked Pentium in check**

Mordor minimum of 36fps is decent, but its Battlefield 4 pace of 26fps is only just playable, and the 22fps minimum in Crysis 3 made the game unplayable.

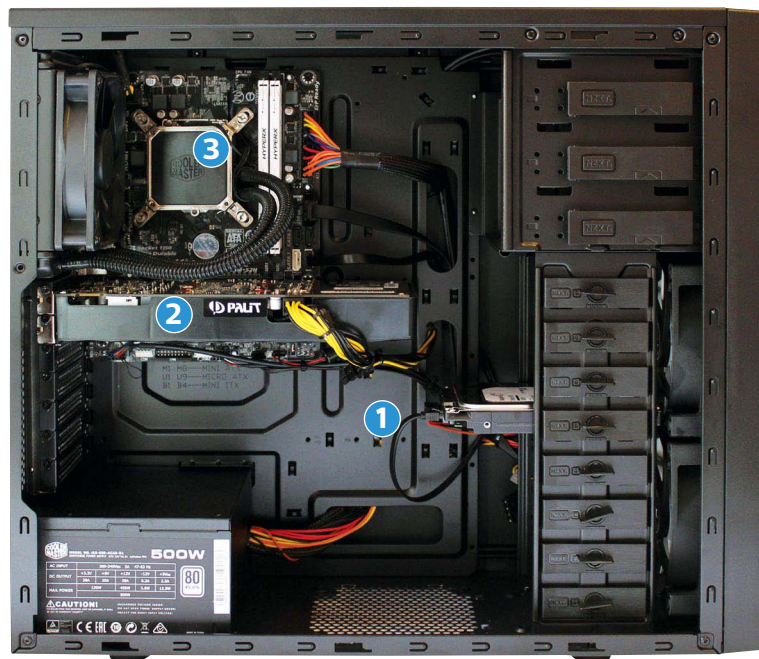
You can't expect rapid loading times in games either. The Seagate hard disk returned read and write speeds of 189MB/sec and 139MB/sec respectively, which is fine for a hard disk, but a fraction of the speed of a standard SSD.

On the plus side, there are no issues with heat. The CPU's top delta T of 61°C is fine considering the overclock, and the GPU delta T of 50°C at load is fine too. The power draw isn't bad either; at idle this machine needed just 64W, and it drew just 216W from the mains when stress-tested.

The CyberPower isn't quiet though. When idle, its rumble is distracting, and louder than many high-end gaming rigs, and its mid-game noise levels will need to be drowned out by loud music or a good pair of headphones. Investigation revealed the two front-mounted 120mm case fans as the culprits – without them, the CyberPower is far quieter. It's a silver lining to this particular cloud, as they're the easiest fans in this machine to replace with quieter models.

Conclusion

CyberPower's budget build has plenty going for it: the overclocked Intel Pentium processor punches above its weight, and the GTX 960 is a capable card for 1080p



gaming. The hard disk is capacious, and the case is sturdy. However, the motherboard is restrictive, there's no SSD and the fans are loud. The CyberPower remains a decent choice if you want a 1080p gaming rig for a bargain price, but be aware of its limitations too. For an extra £100, this PC could be built with a small SSD and a Z97 motherboard, which would make it a much better balanced system.

MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING



HANDBRAKE H.264 VIDEO ENCODING



LUXMARK OPENCL



HEAVY MULTITASKING



SYSTEM SCORE



INTEL REFERENCE: 51.22%

SPEED
19/25

DESIGN
19/25

HARDWARE
16/25

VALUE
24/25

OVERALL SCORE
78%

BATTLEFIELD 4

1,920 x 1,080, Ultra Detail, 4x AA



2,560 x 1,440, Ultra Detail, 4x AA



SHADOW OF MORDOR

1,920 x 1,080, Ultra Detail, 4x AA



2,560 x 1,440, Ultra Detail, 4x AA

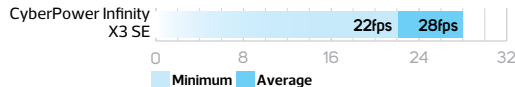


CRYSIS 3

1,920 x 1,080, Very High Detail, 0x AA



2,560 x 1,440, Very High Detail, 0x AA



VERDICT

Impressively adept at 1080p gaming for the money, never dropping below 30fps, but its budget makes it restrictive in several key areas.

GAMING PC

Eclipse Excalibur i7582n970-OC / **£1,500** inc VATSUPPLIER www.eclipsecomputers.com

Every component of the hefty Eclipse Excalibur seems designed to make a statement. The Corsair Graphite 760T case is huge, in equal parts black and white, and with side panels that open on hinges and consist almost entirely of see-through plastic. The Asus graphics card is clad in a white metal cover, and the Asus X99-S motherboard shares the white and black theme. Meanwhile, the Corsair Hydro H110i GT liquid cooler has a 240mm radiator in the roof with two pipes that swoop down dramatically to the processor.

The Corsair chassis' meshed front panel pops off to reveal a dust filter and easy fan access, and a magnetic slab of plastic across the top serves the same function. Both sides swing open on smooth, solid hinges, revealing a smart interior. The huge motherboard tray is ringed with rubber-lined cable holes, and the six hard disk bays are divided between two small cages at the bottom of the chassis – a sensible design that means airflow from the two 140mm fans at the front isn't impeded.

Those fans have smart white LEDs, and the case sits on tall plastic feet that allow air intake from the bottom. The case's build quality is impressively sturdy, and the quality of Eclipse's build complements this slick design. The Excalibur's cables are tied in rigid lines, while others are routed between motherboard components, and they're kept similarly neat around the back, with cable ties employed to keep wires in check.

The case's sheer size also means there's plenty of room to grow. Five hard disk bays are empty and come with tool-free caddies, and there are four dedicated 2.5in bays around the back and a pair of 5.25in bays at the front. There's ample room for a second graphics card too.

The Asus X99-S motherboard plays its part well. Its four spare memory slots can take the total RAM to 64GB, and there are four free 16x PCI-E 3 slots below the graphics card. Storage can also be expanded hugely thanks to eight SATA 6Gbps ports, and an M.2 port is installed vertically, using a metal bracket to hold drives in place. The motherboard also has dedicated audio circuitry and on-board buttons alongside a two-character POST display. It's swimming with ports too. The back panel has eight USB 3 connectors, two USB 2 ports, a BIOS Flashback button, optical S/PDIF and five audio connectors, and the front of the chassis has USB 3, USB 2 and audio ports.

Meanwhile, the Core i7-5820K might be the most affordable Haswell-E part, but it still has six cores and a mighty 15MB of L3 cache. Eclipse has overclocked this 3.3GHz chip to 4GHz. Then there's the GTX 970, which comes from Asus' Turbo range, which means the Maxwell core has



been overclocked from 1050MHz to 1088MHz, although the 4GB of GDDR5 memory still runs at 7010MHz. The rest of the specs list ticks the high-end PC boxes. There's 16GB of 2666MHz DDR4 memory, a 2TB hard disk, a Blu-ray writer and a 256GB Hynix SSD boot drive.

It sounds good so far, but Scan's 3XS Z170 Vengeance (see p66), which comes with a quad-core Skylake CPU, the latest Intel Z170 chipset, a PCI-E SSD and a GTX 980.

The Eclipse's warranty isn't the best deal we've seen either. There's a year of parts and labour coverage, which is fine, but only a month is collect and return – after that it's return to base, with a further two years covering labour only. Comparatively, the Scan PC has a year on-site and then two years return-to-base cover, including both parts and labour.

Performance

The Core i7-5820K overclock helped it to romp through our multi-threaded benchmarks. Its video encoding result of 363,096 and multi-tasking result of 180,649 are excellent, and both better than the aforementioned Scan machine. Its image editing score of 51,460 is average compared to cheaper chips with fewer cores at higher frequencies, but there's no disputing the overall result of 151,670 – it's 35 per cent better than our Intel reference rig, and a few thousand points ahead of Scan's Skylake system.

Meanwhile, the overclocked GTX 970 blitzed our 1080p tests. Its Battlefield 4 and Shadow of Mordor minimums of 59fps and 60fps are excellent, and it managed a rapid 44fps in Crysis 3. The Eclipse proved capable at 2,560 x 1,440 too. It never dropped below 37fps in Battlefield 4 and 42fps in Shadow of Mordor, and its minimum of 28fps in Crysis 3 is reasonable, if not outstanding. The higher demands of 4K gaming proved too much for the GTX 970 though.

/SPECIFICATIONS

CPU 3.3GHz Intel Core i7-5820K overclocked to 4GHz

Motherboard Asus X99-S

Memory 16GB Corsair Vengeance LPX 2666MHz DDR4

Graphics Asus GeForce GTX 970 4GB

Storage 256GB Hynix SH910 SSD; 2TB Seagate Barracuda hard disk

Case Corsair Graphite 760T

Cooling CPU: Corsair Hydro H110i GT with 2 x 140mm fans; GPU: 1 x 70mm fan; Front: 2 x 140mm fans; rear: 1 x 140mm

PSU Corsair CS750M 750W

Ports Front: 2 x USB 3, 2 x USB 2, 2 x audio; Rear: 8 x USB 3, 2 x USB 2, 1 x Gigabit Ethernet, 1 x optical S/PDIF, 5 x audio

Operating system Windows 8-164-bit

Warranty One year parts and labour, plus two years labour only. One month collect and return, then return to base

- 1** Eclipse has overclocked the Core i7-5820K chip to 4GHz
- 2** The Asus GTX 970 card is adept at handling gaming up to 2,560 x 1,440
- 3** Cables are hidden behind the motherboard to keep the build tidy

Then there's the Hynix SSD, which is fast enough, but outpaced by rivals. Its sequential read speed of 498MB/sec is decent, but its write pace of 387MB/sec is a tad disappointing. It's still far quicker than any hard disk, but it's unable to compete with PCI-E-based storage – the Scan's SSD, for instance, romped through the same tests at 1,928MB/sec and 1,120MB/sec respectively.

On the plus side, our thermal tests didn't highlight any issues. The processor's delta T of 63°C is a little high, but no cause for major concern, and the graphics card topped out at a perfectly reasonable 52°C. Noise output is moderate – for the most part, it isn't annoying, but the two fans on the CPU cooler make a fair amount of noise, including a loud whoosh when the CPU needs a cooling boost. There isn't much point in using the fan control of the front of the machine either; it changes the speed of the case fans, but not enough to make a significant difference.

Conclusion

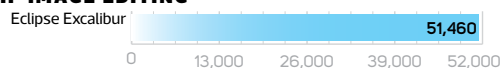
The Eclipse Excalibur has huge multi-threaded processing power, a great motherboard and a massive, versatile chassis. It's also great to see decent LGA2011-v3 gaming systems in this price bracket. However, it's up against some stiff competition. The GeForce GTX 970 is a fine card, but it's outpaced by the Scan's GTX 980, and the SSD is similarly



outperformed. The Eclipse is noisier than the Scan too, and a little more expensive. However, if getting faster multi-threaded performance is more important to you than faster frame rates, the Excalibur is a well-priced, fast and well-built Haswell-E machine.

MIKE JENNINGS

CPC REALBENCH 2015 GIMP IMAGE EDITING



HANDBRAKE H.264 VIDEO ENCODING



LUXMARK OPENCL



HEAVY MULTITASKING



SYSTEM SCORE



INTEL REFERENCE: 135.52%

SPEED
22/25

DESIGN
22/25

HARDWARE
21/25

VALUE
20/25

OVERALL SCORE
85%

BATTLEFIELD 4

1,920 x 1,080, Ultra Detail, 4x AA



2,560 x 1,440, Ultra Detail, 4x AA

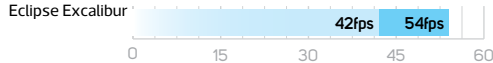


SHADOW OF MORDOR

1,920 x 1,080, Ultra Detail, 4x AA



2,560 x 1,440, Ultra Detail, 4x AA

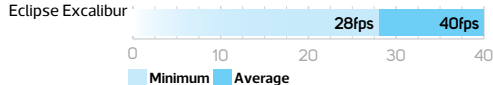


CRYSIS 3

1,920 x 1,080, Very High Detail, 0x AA



2,560 x 1,440, Very High Detail, 0x AA



VERDICT

Fast in multi-threaded benchmarks, and fine for gaming at 2,560 x 1,440, but it's a little noisy and other machines offer a better balance of components for similar money.

GAMING PC

Scan 3XS Z170 Vengeance / £1,449 inc VAT

SUPPLIER www.scan.co.uk

The Scan 3XS Z170 Vengeance is the first PC we've seen with an Intel Skylake processor, and Scan hasn't just installed a new bit of silicon – it's overclocked the chip too. We've fully explored Skylake on p17, but many of the new additions add features rather than a CPU core speed boost. There's support for DDR4 memory at faster speeds, a separate voltage regulator on the motherboard, better granularity when overclocking with the base clock and a new socket called LGA1151.

The new Z170 chipset, dubbed Sunrise Point, also adds new features. It can dish out ten USB 3 ports and six SATA ports with no need for third-party controllers.

It also has up to 20 PCI-E 3 lanes of its own (in addition to the 16 lanes in the CPU), and M.2 SSDs can use four of them – a move that should enable blistering transfer speeds.

The Core i7-6700K deployed by Scan has a stock speed of 4GHz, four Hyper-Threaded cores and 8MB of L3 cache. It's unlocked too, so Scan has overclocked it to 4.6GHz. Skylake offers the ability to fine-tune overclocks with the base clock, but Scan has kept it simple here: a 100MHz base clock, a 46x multiplier and a 1.35V core.

The Skylake chip plugs into a brand-new Asus Z170 Pro Gamer motherboard. It doesn't have the fancy ROG extras, such as on-board power buttons or LED displays, but it's packed with all the benefits of the Z170 chipset as well as a decent slate of features. There's an Asus-made dedicated audio circuit, three spare 1x PCI-E slots, a pair of empty 16x PCI-E slots and plenty of vacant SATA ports. It also has two free memory slots, and a slick row of red lights that illuminate its logo.

Right in the middle of the rig is an EVGA GeForce GTX 980. It's a Superclocked version, which means big speed boosts – the 1126MHz standard GPU clock has been upped by 100MHz, while its 4GB of GDDR5 memory sticks at its stock speed of 7010MHz.

The storage impresses too. The Samsung M.2 SSD uses four PCI-E 3 lanes to operate at full speed in this machine, and it's paired with a 2TB hard disk. Scan has also installed a card reader, as well as a DVD writer.

Meanwhile, the Corsair Obsidian 450D is smaller and more understated than the huge Corsair chassis used by Eclipse (see p64), but its matt black finish looks great, and build quality is solid. The front panel pops off for fan access, and the roof has a handy magnetic dust filter. The chassis is practical on the inside too. There's a hard disk cage at the bottom with two empty tool-free bays, and another is included with the PC if you want to add more storage. There are



two free SSD cages behind the back panel too, as the M.2 drive is installed beneath the chipset.

Scan's build quality helps too. The PC's cables are tidy around the front, and they're even better around the back – they're held in place by sticky pads and cable ties – and the PC even includes a 16GB USB stick on the inside of the chassis that's full of diagnostic tools.

Scan also offers one of the best warranties in the business. The first year is covered by an on-site deal, and parts and labour are covered for a further two years with a return-to-base deal.

Performance

The Core i7 Skylake chip is an evolution of existing technologies rather than an architectural revolution, so we're not expecting this PC to prove record-breaking in benchmarks. That said, this PC's image editing score of 68,527 is still a cracking result. Meanwhile, the Scan machine's impressive video encoding and multi-tasking scores of 326,319 and 178,483 beat the scores from Chillblast Fusion Wolf Devil's Canyon rig (see Issue 144, p56) by a significant margin. The Scan can't keep up with the Eclipse Excalibur's Haswell-E chip in multi-threaded tests (see p64), but for a quad-core chip, the Skylake Core i7 chip's multi-threading performance is still formidable.

The overclocked GTX 980 also proved very capable in our game benchmarks. At 2,560 x 1,440, its Battlefield 4 minimum of 52fps is great, and its Shadow of Mordor pace of 50fps is similarly impressive. Even in Crysis 3, our toughest test, it managed a decent 43fps minimum. The GTX 980 can handle some games at 4K too. Its Shadow

/SPECIFICATIONS

CPU 4GHz Intel Core i7-6700K overclocked to 4.6GHz

Motherboard Asus Z170 Pro Gamer

Memory 8GB Corsair Vengeance LPX 2666MHz DDR4

Graphics EVGA GeForce GTX 980 4GB

Storage 256GB Samsung SM951 PCI-E SSD; 2TB Western Digital Green hard disk

Case Corsair Obsidian 450D

Cooling CPU: Corsair Hydro H80i GT with 2 x 120mm fans; GPU: 2 x 85mm fans; Front: 2 x 140mm fans

PSU Corsair CS550M, 550W

Ports Front: 2 x USB 3, 2 x audio; Rear: 1 x USB 3.1, 4 x USB 3, 2 x USB 2, 1 x USB type C, 1 x Gigabit Ethernet, 1 x optical S/PDIF, 1 x PS/2, 5 x audio

Operating System Windows 10 Home 64-bit

Warranty Three years parts and labour, with one year on site and two years return to base

- 1 Thanks to the Z170 chipset, the M.2 Samsung SSD dishes out amazing performance
- 2 The Skylake Core i7-6700K processor has been overclocked to 4.6GHz
- 3 The GTX 980 in this EVGA Superclocked card has been overclocked by 100MHz

of Mordor minimum at this higher resolution was a reasonable 35fps. Both Battlefield 4 and Crysis 3 were below our playable threshold at this resolution though.

Perhaps the star of the show is the Samsung SSD, which is blisteringly quick thanks to the new chipset. In our sequential read and write tests, it ran at 1,928MB/sec and 1,120MB/sec – several times faster than the traditional SATA SSD in the Eclipse machine.

The Scan's thermal and noise performance was decent too. Its processor delta T of 68°C is a tad high, but still within thermal limits, and the graphics card's delta T of 47°C is a great result for such a powerful GPU. The noise levels were better than those of the rumbling Eclipse too – the Scan produced discreet whirr when idle, and the noise only increased by a tiny margin during gameplay.

Conclusion

Scan's machine isn't as flashy as the monster Eclipse, but its GTX 980 is faster in games and the M.2 SSD is one of the fastest drives we've ever seen when paired with the new Z170 chipset.

Also, while the Scan isn't as quick in multi-threaded tests as a Haswell-E machine, the Core i7-6700K still handles multi-threading surprisingly well. With fast performance in



all the key areas, great build quality, low noise levels and decent warranty coverage, the Scan 3XS Z170 Vengeance is a great gaming PC for this price league.

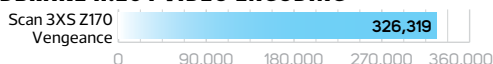
MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING



HANDBRAKE H.264 VIDEO ENCODING



LUXMARK OPENCL



HEAVY MULTITASKING



SYSTEM SCORE



INTEL REFERENCE: 128.6%

SPEED
24/25

DESIGN
23/25

HARDWARE
23/25

VALUE
22/25

OVERALL SCORE
92%

BATTLEFIELD 4

2,560 x 1,440, Ultra Detail, 4x AA



3,840 x 2,160, Ultra Detail, 4x AA



SHADOW OF MORDOR

2,560 x 1,440, Ultra Detail, FXAA



3,840 x 2,160, Very High Detail, FXAA



CRYSIS 3

2,560 x 1,440, Very High Detail, 0x AA



3,840 x 2,160, Very High Detail, 0x AA



Minimum Average

VERDICT






The Skylake platform delivers good pace and features for both CPUs and SSDs, and this Scan machine is also well built, quiet and fast in games.

Elite

Our choice of the best hardware available

Build a mini APU PC

The parts you'll need to build an affordable, general-purpose mini PC that's ideal for putting in the lounge, based on an AMD APU. This machine will handle general computing and media tasks with no trouble, as well as basic gaming, although you'll have to lower the detail settings.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	SilverStone Fortress FTZ01	www.scan.co.uk	Issue 144, p84	£110
	Gigabyte F2A88XN-WiFi	www.cclonline.com	Issue 144, p84	£80
	AMD A10-7870K	www.ebuyer.com	Issue 144, p22	£106
	8GB Corsair Vengeance Pro 2400MHz (CMY8GX3M2A2400C11R)	www.scan.co.uk	Issue 144, p84	£45
	Cooler Master Seidon 120V	www.scan.co.uk	Issue 144, p84	£38
	256GB Crucial BX100	www.scan.co.uk	Issue 144, p84	£68
	SilverStone SST-ST30SF	www.scan.co.uk	Issue 144, p84	£41
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£556

Z97 SERIES MOTHERBOARDS
OVER 500 AWARDS



ASUS
IN SEARCH OF INCREDIBLE

Build a budget gaming PC

The parts you'll need to build a budget machine capable of playing the latest games at maximum settings on a 1080p monitor. The machine has a discrete graphics card, a highly overclockable dual-core CPU and high-speed memory. Meanwhile, the Z97 motherboard gives you headroom to upgrade to a faster CPU later.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
	ASRock Z97 Pro3	www.scan.co.uk	Issue 130, p50	£72
	Intel Pentium G3258	www.scan.co.uk	Issue 132, p17	£52
	8GB Corsair Vengeance Pro 2400MHz DDR3 (CMY8GX3M2A2400C11R)	www.scan.co.uk	Issue 132, p22	£45
	Asus Radeon R9 380 Strix Gaming DirectCU II OC 2GB UPDATED	www.scan.co.uk	Issue 145, p27	£176
	250GB Crucial BX100	www.scan.co.uk	Issue 144, p84	£65
	SilverStone Argon AR01	www.scan.co.uk	Issue 132, p57	£26
	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£67
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£55
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£686

THE WORLD'S **BEST-SELLING** AND
MOST AWARD-WINNING **MOTHERBOARDS**













ASUS
IN SEARCH OF INCREDIBLE

Build a mid-range PC

Work PC

The parts you'll need to build a solid quad-core PC with plenty of upgrade potential. This kit list gives you an all-in-one liquid cooler and a K-series Core i5 CPU, meaning you can overclock it and get some serious processing power. We've managed to get the Core i5-4690K Haswell CPU up to 4.8GHz, so it has some serious performance potential. Also included is a solid Corsair PSU, a 500GB SSD and 8GB of high-speed memory. The core configuration assumes you won't be doing any serious gaming, however, and it relies on Intel's integrated graphics.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT Phantom 530	www.overclockers.co.uk	Issue 127, p44	£98
	Gigabyte Z97X-SLI	www.eclipsecomputers.com	Issue 130, p54	£91
	Intel Core i5-4690K	www.scan.co.uk	Issue 132, p18	£187
	8GB Corsair Vengeance Pro Series 2400MHz DDR3 (CMY8GX3M2A2400C11R)	www.scan.co.uk	Issue 132, p22	£45
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£70
	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£67
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£55
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Crucial BX100 500GB	www.ebuyer.com	Issue 141, p43	£135
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£826

Gaming PC

The graphics card you'll need to play current games at their maximum settings at 1080p and 2,560 x 1,440.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	1,920 x 1,080 UPDATED Asus Radeon R9 380 Strix Gaming DirectCU II OC 2GB	www.scan.co.uk	Issue 145, p27	£176
	2,560 x 1,440 Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p48	£246

AWARD-WINNING X99 SERIES MOTHERBOARDS
EXTREME X99 THRILLS












ASUS
IN SEARCH OF INCREDIBLE

Build a performance PC

Work PC

The parts you'll need to build a high-quality, fast PC that's ideal for multi-threaded workloads. This kit list features a high-quality, well-built case, a feature-rich motherboard and an Intel Skylake Core i7-6700K CPU. This processor's support for Hyper-Threading splits the resources of the CPU's four physical cores into a further four virtual cores, meaning it can effectively handle eight threads at once. There's also a solid 850W PSU, giving you plenty of headroom for overclocking and adding multiple graphics cards, 16GB of DDR4 memory and an all-in-one liquid cooler.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Cooler Master Cosmos SE	www.cclonline.com	Issue 144, p41	£125
	Asus Z170 Deluxe UPDATED	www.scan.co.uk	Issue 145, p22	£245
	Intel Core i7-6700K UPDATED	www.scan.co.uk	Issue 145, p17	£287
	16GB Corsair Vengeance LPX 2666MHz DDR4 (CMK16GX4M2A2666C16) UPDATED	www.scan.co.uk	Issue 145, p24	£102
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£70
	SilverStone Strider Gold 850W	www.overclockers.co.uk	Issue 135, p56	£110
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£55
	Samsung 850 Evo 500GB	www.scan.co.uk	Issue 141, p51	£140
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68
			TOTAL	£1,202

Gaming PC

The graphics card you'll need to play current games at their maximum settings at 2,560 x 1,440 and beyond.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	2,560 x 1,440 Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p48	£246
	4K 2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p50	£492

Recommended extra

A discrete sound card gives you higher-quality sound when playing back or recording music.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Creative Sound Blaster Z	www.scan.co.uk	Issue 116, p42	£62

Z170 SERIES MOTHERBOARDS
UPGRADE TO INTEL 6TH GEN














ASUS
IN SEARCH OF INCREDIBLE

Build a 6-core workstation

Multi-threaded workstation

The parts you'll need to build a PC with serious power in multi-threaded workstation software, such as 3D rendering apps and optimised distributed computing software. The kit list features a 6-core LGA2011-v3 CPU, which is overclockable using the motherboard and cooler listed. Also supplied is 16GB of RAM, 1TB of solid state storage and a 1.2kW PSU, providing loads of headroom for adding multiple GPUs.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Phanteks Enthoo Luxe	www.eclipsecomputers.com	Issue 144, p53	£117
	Asus X99 Deluxe	www.overclockers.co.uk	Issue 136, p20	£300
	Intel Core i7-5820K	www.scan.co.uk	Issue 134, p43	£300
	Asus Radeon R9 380 Strix Gaming DirectCU II OC 2GB	www.scan.co.uk	Issue 145, p27	£176
	16GB Corsair Vengeance LPX 2666MHz DDR4 (CMK16GX4M4A2666C16)	www.scan.co.uk	Issue 136, p14	£114
	Corsair Hydro Series H110i GT	www.eclipsecomputers.com	Issue 140, p17	£92
	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£253
	Samsung 850 Evo 1TB	www.cclonline.com	Issue 141, p51	£281
	Seagate Barracuda 2TB ST2000DM0001	www.scan.co.uk	Issue 104, p75	£55
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Microsoft Windows 7 Professional OEM (or Windows 8.1 if you're using a 4K monitor)	www.ebuyer.com	Issue 75, p46	£111
			TOTAL	£1,809

4K gaming PC

This LGA2011-v3 system can support multiple graphics cards over 28 PCI-E 3 lanes, making it an ideal foundation for high-resolution PC gaming, replacing the graphics card listed above with two high-spec cards. We recommend using Windows 8.1, rather than Windows 7, if you're using a 4K monitor.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	4K 2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p50	£492
			TOTAL	£2,125



STRIX GTX 980 TI
GAMING GRAPHICS CARDS

30% COOLER. 0dB GAMING.












ASUS
IN SEARCH OF INCREDIBLE

Build a mini PC

Core components

The parts you'll need to build either PC. This kit list gives you a solid PSU, 8GB of RAM, an overclockable Haswell CPU, an all-in-one liquid cooler and Windows 7 Home Premium. Also included is a short-PCB graphics card that can play current games at their maximum settings at 2,560 x 1,440, and a 512GB SSD.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Intel Core i5-4690K	www.scan.co.uk	Issue 132, p18	£187
	8GB Corsair Vengeance Pro Series 2400MHz DDR3	www.scan.co.uk	Issue 132, p22	£45
	Corsair H75	www.scan.co.uk	Issue 138, p46	£63
	Asus GeForce GTX 970 DirectCU Mini	www.overclockers.co.uk	Issue 139, p20	£300
	Crucial BX100 500GB	www.ebuyer.com	Issue 141, p43	£135
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£55
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£67
	Microsoft Windows 7 Home Premium 64-bit OEM	www.ebuyer.com	Issue 75, p46	£68



Mini-ITX PC

The parts you'll need to build a pint-sized powerhouse.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Corsair Obsidian 250D	www.scan.co.uk	Issue 136, p41	£75
	Asus Maximus VII Impact	www.overclockers.co.uk	Issue 136, p52	£183
			TOTAL	£1,188

Micro-ATX PC

The parts you'll need to build a mini PC that doesn't take up as much room as a full-sized desktop.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£67
	Asus Maximus VII Gene	www.overclockers.co.uk	Issue 133, p18	£160
			TOTAL	£1,157











ROG Sica Gaming Mouse and ROG Whetstone mouse pad

CUSTOMISED FOR BATTLE








ASUS
IN SEARCH OF INCREDIBLE

Cases

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Budget ATX	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
	Sub-£100 ATX quiet	Fractal Design Define R5	www.scan.co.uk	Issue 137, p20	£77
	Sub-£100 ATX performance	NZXT Phantom 530	www.overclockers.co.uk	Issue 127, p44	£98
	Sub-£150 full-sized ATX quiet	Nanoxia Deep Silence 5	www.quietpc.com	Issue 144, p50	£113
	Sub-£150 full-sized ATX	Phanteks Enthoo Luxe	www.eclipsecomputers.com	Issue 144, p53	£117
	Sub-£150 mid-size ATX	Cooler Master Cosmos SE	www.cclonline.com	Issue 144, p41	£125
	Mini-ITX tower	Corsair Obsidian 250D	www.scan.co.uk	Issue 136, p41	£75
	Mini-ITX cube	Antec ISK600	www.overclockers.co.uk	Issue 126, p28	£50
	Micro-ATX	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£67
	Water-cooling micro-ATX	Parvum Systems S2.0	www.overclockers.co.uk	Issue 129, p22	£140

Graphics cards

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	1,920 x 1,080 gaming	Asus Radeon R9 380 Strix Gaming DirectCU II OC 2GB UPDATED	www.scan.co.uk	Issue 145, p27	£176
	2,560 x 1,440 gaming	Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p48	£246
	High-end single-GPU gaming	Nvidia GeForce GTX 980 Ti	www.scan.co.uk	Issue 143, p20	£498
	4K gaming	2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p49	£492
	Mini-ITX	Asus GeForce GTX 970 DirectCU Mini	www.overclockers.co.uk	Issue 139, p20	£300

STRIX R9 390X | R9 390 GAMING GRAPHICS CARDS
30% COOLER. 0dB GAMING.





ASUS
 IN SEARCH OF INCREDIBLE







Power supplies

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Mid-range 550W	Corsair CS550M	www.scan.co.uk	Issue 135, p46	£67
	High-end 750W	Corsair HX750i	www.dabs.com	Issue 135, p52	£122
	Mid-range 850W	SilverStone Strider Gold 850W	www.overclockers.co.uk	Issue 135, p56	£110
	High-end 1.2kW	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£253

Networking

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Router	Asus RT-AC68U	www.scan.co.uk	Issue 128, p88	£145
	Wi-Fi adaptor	Asus PCE-AC68	www.scan.co.uk	Issue 128, p88	£67

Storage






	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Hard disk	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£55
	250GB SSD	Crucial BX100 250GB	www.ebuyer.com	Issue 141, p43	£65
	500GB SSD	Crucial BX100 500GB	www.ebuyer.com	Issue 141, p43	£132
	1TB SSD	Samsung 850 Evo 1TB	www.cclonline.com	Issue 141, p51	£281
	High-performance SSD	Intel SSD 750 1.2TB	www.scan.co.uk	Issue 143, p24	£814
	NAS box	Synology DS215J	www.cclonline.com	Issue 138, p17	£134

ASUS ROUTERS.
FASTEST SPEED. FARTHEST COVERAGE.










ASUS
IN SEARCH OF INCREDIBLE

Monitors

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	24in monitor	Dell U2414H	www.overclockers.co.uk	Issue 129, p43	£200
	29in monitor	Asus PB298Q	www.scan.co.uk	Issue 129, p52	£293
	28in 4K monitor	Asus PB287Q	www.scan.co.uk	Issue 133, p44	£393
	G-Sync monitor	Asus ROG Swift PG278Q	www.eclipsecomputers.com	Issue 143, p44	£600
	FreeSync monitor	BenQ XL2730Z	www.overclockers.co.uk	Issue 143, p46	£500

Peripherals







	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Budget mechanical keyboard	Gigabyte Aivia Osmium	www.awd-it.co.uk	Issue 139, p40	£72
	Mechanical gaming keyboard	CM Storm Trigger-Z	www.ebuyer.com	Issue 139, p44	£80
	Mechanical MMO keyboard	Corsair Vengeance K95	www.awd-it.co.uk	Issue 123, p64	£125
	Gaming mouse	Logitech G402 Hyperion Fury	www.currys.co.uk	Issue 139, p53	£40
	Wireless gaming mouse	SteelSeries Sensei Wireless	www.box.co.uk	Issue 139, p61	£84
	Flight stick	Saitek X-55 Rhino H.O.T.A.S.	www.overclockers.co.uk	Issue 131, p29	£170
	Steering wheel and pedals	Thrustmaster TX Ferrari 458 Italia Edition	www.overclockers.co.uk	Issue 137, p32	£265

No.1
Gaming Monitor Brand











ASUS
IN SEARCH OF INCREDIBLE

Audio

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	PCI-E sound card	Creative Sound Blaster Z	www.scan.co.uk	Issue 116, p42	£62
	USB DAC	Asus Xonar Essence One	www.overclockers.co.uk	Issue 118, p44	£363
	2.1 speakers	Acoustic Energy Aego M	www.amazon.co.uk	Issue 142, p52	£165
	Soundbar	Razer Leviathan	www.overclockers.co.uk	Issue 142, p57	£165
	Headset	HyperX Cloud II	www.ebuyer.com	Issue 142, p46	£70
	Surround-sound headset	Asus Strix 7.1	www.cclonline.com	Issue 142, p43	£151

Systems

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Sub-1,000 gaming PC	Box Cube Aero Series Watercooled Gaming	www.box.co.uk	Issue 143, p56	c.£999
	Quiet gaming PC	Chillblast Fusion Serenity	www.chillblast.co.uk	Issue 138, p66	c. £1,499
	Dream PC	Scan 3XS Barracuda UPDATED	www.scan.co.uk	Issue 145, p58	£9,499
	Sub-£2,000 gaming PC	Scan 3XS X99 Carbon Ti	www.scan.co.uk	Issue 143, p58	c.£1,999
	Skylake PC	Scan 3XS Z170 Vengeance UPDATED	www.scan.co.uk	Issue 145, p66	c. £1,449
	Mini-ITX PC	PC Specialist Nemesis Evo	www.pcspecialist.co.uk	Issue 144, p58	c. £1,599
	Gaming laptop	MSI GT70 2PC Dominator	www.overclockers.co.uk	Issue 129, p26	c. £1,320
	Premium PC	Overclockers UK Infin8 Emperor UPDATED	www.overclockers.co.uk	Issue 145, p44	£5,399

Strix gaming series

UNLEASH YOUR GAMING INSTINCTS

STRIX



ASUS
IN SEARCH OF INCREDIBLE

Games



Featured this month

Inverse look p79 / Batman: Arkham Knight p80 / RONIN p82 / Feist p82 /
F12015 p84 / The engine room – SCUMM p86 / Gaming archaeology p90



RICK LANE / INVERSE LOOK

BREAKING THE CONSOLE CYCLE

We're knee deep in another console cycle, but PC gaming is still thriving, says Rick Lane

Remember when PC gaming was dead? It wasn't, of course, but the major publishers' attitude towards that box underneath your desk suggested it had kicked the bucket. Between 2008 and 2010, when the Xbox 360 and PS3 were at their most popular, the likes of Microsoft, Ubisoft and EA were looking at the PC like a teacher watching that one kid in class who just won't sit down and do as he's told.

Microsoft tried and failed to turn the PC into an Xbox-style platform with the atrocious Games For Windows Live, while a slew of shoddy ports, delayed releases and DRM scandals suggested that EA and Ubisoft had given up on the PC. Then, as PC power started rocketing away from the consoles' aging hardware, publishers realised that their constant push for better visuals meant the PC was the only place to realistically showcase games, while Steam's rapid ascendance made Microsoft's shenanigans basically irrelevant.

But now we're at the heart of another console cycle, and the major publishers are up to their old tricks. Most recently, *Batman: Arkham Knight* was released on PC in such a shoddy state that it had to be removed from sale (the game itself is quite good, as you'll see on p80). It later transpired that Warner Bros had outsourced the port to another developer that was only experienced in console games, and it knew about the PC problems months before the game was released.

Then there was the strange case of *The Witcher 3*. The *Witcher* series is one of the PC's biggest success stories, going from the rough but interesting first game released in 2007, to one of the

greatest RPGs ever created in *Wild Hunt*. But despite being a multi-platform title with a strong PC heritage, it was mainly marketed as a PS4 game. Indeed, Namco Bandai originally only sent PS4 review copies to the press, with Xbox and PC critics having to wait until release to get their hands on it.

All of which suggests that a dismissive attitude towards the PC is happening again, although I doubt the tiresome nonsense of 2008 will return. The main difference between now and then is the huge growth of Steam. In 2008, Steam was only just beginning to show glimpses of the PC gaming behemoth it

would become. Nowadays, if you want a shot at your PC game being a success, you have to deal with Steam. Even EA and Ubisoft, with their alternative distribution platforms, still release most of their games on Steam eventually. Plus Steam is even getting into the hardware business itself now.

The situation has also become more interesting with the arrival of Steam refunds, which lets you trade in a game you've bought provided you played it for under two hours. While there were initial concerns that this scheme would affect small indie devs making short games, it might provide a wake-up call for major publishers releasing lazy ports. Indeed, there's strong indication that the withdrawal of *Batman: Arkham Knight* from sale was in part due to the vast number of refund requests Warner Bros received. Big publishers can no longer treat the PC as a secondary platform without consequence, which means we have nothing to worry about, despite the popularity of current consoles. **GPG**

Arkham Knight was released on PC in such a shoddy state that it had to be removed from sale

Rick Lane is Custom PC's games editor. [@Rick_Lane](#)



Batman: Arkham Knight / £34.99 inc VAT

DEVELOPER Rocksteady Studios / PUBLISHER Warner Bros / WEBSITE www.batmanarkhamknight.com

A day after its release, the PC version of Batman: Arkham Knight was withdrawn from sale due to widespread complaints about severe performance issues on all but the highest-end machines. Our own experience of Rocksteady's latest game was relatively stable, though, so we're able to discuss what the game itself is like, and whether it will be worth picking up when the technical problems have been addressed and the game re-released.

The short answer to that question is, yes. Arkham Knight is Rocksteady's most complete Batman simulator yet. A larger and truly open Gotham City provides the backdrop to an action-packed yet surprisingly introspective finale to the Arkham series. As with Arkham City, however, the grander scope also lets more flaws creep into the game, and there are times when the Dark Knight stumbles on this climactic journey.

Arkham Knight begins with a sharp reminder of the concluding moments of Arkham City. The Joker is dead, and although not forgotten, Gotham enjoys a brief flicker of peace in the absence of the Clown Prince of Crime.

But the situation changes dramatically as Scarecrow announces his terrifying return in a local café. Partnered with the private army of the mysterious Arkham Knight, he forces an evacuation of the city's central districts. Riots ensue, and all of Batman's old enemies attempt to take advantage of the situation.

It's certainly the sternest challenge Batman has faced yet, but more interesting is the fact that he might not be

up to the task this time. The events of Arkham City have taken their toll on the caped crusader, and the conflict with Scarecrow only reopens these half-healed wounds.

Given this game is largely about clobbering skinheaded goons while dressed as an unusually aerodynamic rodent, Arkham Knight's storytelling is superb, especially as a character study of Batman himself. The increasing militarisation of his enemies forces Batman to respond in kind, pushing his moral objection to killing to breaking point.

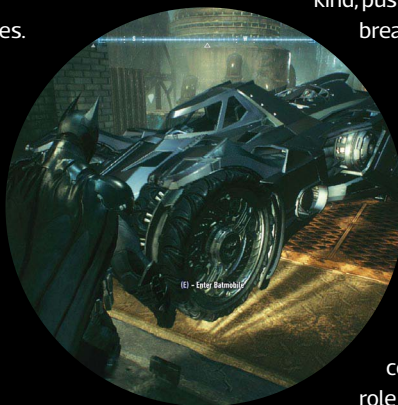
At the same time, his personal connection to the Arkham Knight and a botched early confrontation with Scarecrow causes his mental state to begin unravelling.

It's a fascinating angle from which to explore the character. Batman remains a figure of immense power and fortitude, but one who may no longer be able to control that power, and thus uphold his role as Gotham's protector. We've seen

Batman take a beating before in the Arkham series, but this time we see him failing, and constantly being questioned and undermined not just by vindictive enemies, but by friends and allies concerned by his behaviour.

It's exceptionally well written, but it isn't just the writing doing the work here; Rocksteady employs lots of subtle visual cues and sneaky environmental juggling to convey Batman's altered perception of the world. His fears and doubts become a constant part of his world view, and occasionally threaten to consume him.

Unfortunately, the focus on Batman means other characters are less well rounded. Scarecrow is a superb





replacement for the Joker as the primary antagonist, being grave, malevolent and utterly serious. However, the Arkham Knight lacks the charisma he requires to be believably capable of taking on Batman, and we only catch a glimpse of most of the other characters. The portrayals of the likes of Two-face, Penguin and Catwoman are also fairly generic.

On the plus side, in addition to the great storytelling, the main missions are complex, multilayered blends of environmental puzzle solving and thrilling hand-to-hand combat. The open world is beautiful in an oppressively gothic way, and Rocksteady uses it well for the most part. Side-activities are organised into a series of Most Wanted missions, which involve taking down Gotham's most notorious criminals. From tracking down a serial killer to capturing an arsonist targeting fire stations, these missions are cleverly structured to open up gradually alongside the main story.

However, the opening hours of Arkham Knight are almost overwhelming in the sheer amount of information they throw at you. Alongside grappling with the main story and the Most Wanted side-missions, there's a bunch of new combat moves and predator takedowns to learn, and you also need to familiar yourself with Arkham Knight's biggest new feature, the Batmobile.

The Batmobile isn't just a mode of transport for Batman – it also functions as a tank and a puzzle solving device. To combat the military drones the Arkham Knight uses to control Gotham, the Batmobile can transform into a highly mobile artillery platform, equipped with a heavy 60mm cannon and cluster-missile launchers. Furthermore, the Batmobile can be controlled remotely, a feature that Rocksteady uses to create environmental enigmas where Batman needs to function independently of the Batmobile in order to progress.

The Batmobile is mostly enjoyable, but it's also emphasised far too much, and there are some terrible platforming sections involving the Batmobile, such as navigating it across narrow rooftops. Worst of all are the deeply implausible underground racetracks allegedly built by the Riddler. They're crammed with daft obstacles such as crushing pistons and rotating spikes, often requiring the Batmobile to travel along walls and even upside down. You don't have to suspend your disbelief so much as hang it from a gibbet for the crows.

More generally, there are times when Arkham Knight feels burdened by the sheer number of systems running beneath the pixels. The combat, once so beautifully streamlined, now requires finger stretches across the keyboard that a professional pianist would struggle to perform. The Predator sections, initially pitched as a way to express your bat creativity, also feel much more like hard puzzles with a rigid order of takedown.

The Arkham Knight is still fun on the whole, but it can be difficult to keep track of all the necessary information about enemy types and the appropriate response to them. This information overload is particularly prevalent towards the end of the main story, where the game ramps up the difficulty and throws a few boneheaded autosaves into the mix. The actual ending is good, but you'll be glad when Batman's last long night is over.

RICK LANE

OVERALL SCORE

80%

/ **VERDICT**

Arkham Knight is a big and bold conclusion to the Arkham series, even if it still can't quite equal the simpler pleasures of Arkham Asylum.

RONIN / £10 inc VAT

DEVELOPER Tomasz Wacławek / PUBLISHER Devolver Digital / WEBSITE www.devolverdigital.com/games/view/ronin

RONIN is essentially Kill Bill: The Video game, if Uma Thurman's Bride was repeatedly thwarted on her mission of vengeance by a spotty geek wearing glasses and a starched shirt, shouting 'Mr Henchman! Mr Henchman! It's that girl with the sword again and she's bullying me!' Seconds later, a dozen armed guards would then barge through the door and fill our heroine with more lead than a Tudor face cream.

Don't get us wrong, RONIN *does* have plenty going for it. It's effortlessly stylish and elegantly simple, focusing mainly on one ingenious system, but it's held back by a couple of immensely irritating flaws.

OVERALL SCORE
70%

/ VERDICT

There's elegance and novelty in RONIN's straightforward tale of revenge, but it's marred by clumsy stealth mechanics.



It's a 2D side-scrolling game in which you play an anonymous vigilante who breaks into a corporation's high-security buildings to track down its leaders' business and exact bloody revenge upon them. There's initially a whiff of stealth as you search for a way into each building, grappling up walls, clambering along ceilings and slipping between shadows. Yet no matter how sneaky you are, you'll inevitably be forced into conflict with the many guards patrolling these commercial offices and research facilities.

Combat is turn-based, which might sound odd for an action game, but it works superbly. Unlike most platform games, jumping is tied to the mouse button, with a white arc



Feist / £10 inc VAT

DEVELOPER Finji Studios / PUBLISHER Finji Studios / WEBSITE <http://playfeist.net>

A fitting alternative title to Feist would be Bullying Simulator 2015. Not only does everything in Feist's murky forests hate you with a passion usually reserved for Ebola-infected traffic wardens, but certain creatures seem to actively enjoy inflicting pain and misery upon you. Feist may look cute and pretty, but it will soon have you weeping in the school toilets as it tries to kick down the cubicle door to give you a swirly.

In terms of aesthetics and tone, Feist owes a lot to Limbo.

The silhouetted visuals, physics-based puzzles and general hideousness of the world around you are major components of both games. Add some brightly coloured backgrounds and replace the little boy with a huffing fur-ball, and you have Feist's basic framework. Despite the similarities, Feist is a far more kinetic game about pushing forwards, using momentum and agility to your advantage. Your goal is to rescue the fur-ball's mate, who has been captured by what are best described as evil caveman-bear things, and is being transported through the forest in a wooden cage.

Feist's simple premise is matched by its mechanics. Your controls are limited to running, jumping, picking up and throwing objects, and pushing obstacles in your

OVERALL SCORE
65%

/ VERDICT

Feist is visually striking and mechanically satisfying, but let down by its punishing difficulty.



path, with a heavy use of physics. Leap onto a tree branch, and it bends beneath your weight, and different objects have different mass. A pinecone will travel further when thrown, but will do less damage to an enemy than a log.

In terms of tactility and feedback, Feist is very satisfying, which is just as well as, unlike in Limbo, you often need to confront the monsters in the forests.

From balloon-like flies that stab down with spiky stings, to strange arachnids that appear to have mated with razor blades, Feist is filled with nasty critters, and although you



representing your jump distance on screen. At the same time, each enemy's aim is depicted with a red laser sight, but they only shoot at the end of each turn. To stay alive, you need to leap between these ever-shifting red lines, and cut down enemies with your sword when opportunities arise.

This system adds a satisfying tactical element to every encounter, and is gradually lent depth by the introduction of new opponents and abilities. Cyborg-samurai will kill you instantly if you land near them, while machine gunners spray a line of bullets across the level, reducing your movement options over several turns. To combat the mounting threat, you can learn skills such as the ability to throw your sword, or unleash a fistful of shurikens at them, stunning groups of enemies for a turn.

Unfortunately, RONIN becomes problematic when meting out upgrades. You only gain skill points by completing three additional objectives in each mission, such as not raising any alarms and refraining from killing civilians. However, civilians can raise alarms, and once they've spotted you, there's no way to prevent them from calling it in without killing them. What's more, the latter levels often put you in situations where it's very difficult to avoid them.

Consequently, RONIN forces you into stealth situations for which it isn't really equipped, and you really need those skills to progress through the latter part of the game. The final couple of hours are more frustrating than enjoyable, leaving a bitter taste in the mouth as the credits roll.

RICK LANE



can evade them to some extent, eventually you'll be forced to stand your ground.

That's where the game becomes problematic, as the platforming and combat require precision and timing that isn't matched by the slightly languid movement controls.

Since so much of the game is affected by physics, it can be unpredictable too, which is fine to an extent, but not when the crate or branch on which you're balanced is constantly being rocked and battered by enemies. Worse, during the latter stages, you're constantly mobbed to death

by enemies through no fault of your own, while the caveman-bear things can easily throw you like a tennis ball into all kinds of other hazards.

Feist has its merits, but the second half of the game is more a test of resolve than a pleasurable experience. It also doesn't do anything tremendously exciting or innovative; at its best, it's a competent jumping game. Still, it's pleasingly cathartic to stand up to bigger creatures than you, even if you get your furry head kicked nine times out of ten.

RICK LANE



F1 2015 / £39.99 inc VAT

DEVELOPER Codemasters / PUBLISHER Codemasters / WEBSITE www.codemasters.com/game/f1-2015/

F12015 is a curious example of an annual series update. After a couple of years of coasting around the asphalt, Codemasters has finally made extensive changes to the game's core, resulting in a far more detailed and authentic racing simulation. But these changes come at the cost of other features, while the PC version is noticeably weaker than its console counterparts. The result is a theoretically improved racing game that, in practice, is less fulfilling than previous entries.

But credit where it's due, F12015 sees much greater attention paid to the experience of F1 racing from the driver's perspective. Despite being home to the fastest cars in the world, a Grand Prix is a marathon rather than a sprint, and F12015 represents this challenge properly. Tyre wear

and fuel use have a noticeable effect on your car's handling as the race progresses. The rules of F1 are also rigorously applied, so illegal overtakes and collisions are policed by eagle-eyed invigilators, who mete out warnings and penalties swiftly and mercilessly.

Helping you keep track of all the information is your new race engineer, who constantly informs you about both the race and your car's status. If you're braking too aggressively, he'll warn you that your brakes are

overheating and recommend you ease off. Furthermore, he frequently updates you with information about your position relative to other racers.

This is important, as the driver AI is much more convincing than in previous years. If a driver approaches you on a straight, they'll make a determined effort to overtake you and, even on normal difficulty, will compete fiercely for position in a corner. They even make mistakes, spinning off the track or bumping into other drivers, causing the ominous yellow flag to appear on screen.

Unfortunately, the package in which these changes are wrapped in isn't tantalising. Career mode is gone, replaced with a Championship mode that lets you play as one of the 20 drivers in the 2014 or 2015 season. It's functional as a racing framework, but there's little of the essential human drama. Instead, it heavily mimics TV coverage, making you feel oddly distanced from the race in which you're supposedly participating. There's also no safety car, no ability to run a full qualifying session for any race below 50 per cent duration, and little in the way of extra modes, such as the fantastic Classic Car mode from F12013.

The PC version also has problems. Visually, compared to other platforms, distant objects are blurry and desaturated, while character models are unconvincing. Load times sometimes take several minutes between races too.

There's a sense that F12015 was allowed to drive out of the garage a little too early. The engine is better tuned, but it's missing half the bodywork.

RICK LANE

OVERALL SCORE

60%

/ VERDICT

A better race simulation than its predecessors, but a dearth of content elsewhere makes F12015 an uneven drive.



It's not the perfect home until it's the perfect view

» That's German attitude!



reddot award 2015
winner



SILENT BASE 800 WINDOW

The be quiet! Silent Base 800 Window PC case is simply the perfect home for your valuable components. It offers not only a perfect view inside your PC, but also a great symbiosis of noise prevention and cooling performance, a good usability and an extensive capacity for high-end hardware.

An innovative construction, three pre-installed Pure Wings 2 fans, sound insulation features and tool-free mounting are only a few of the reasons why Silent Base 800 regular and windowed version are the perfect choice for high-end gaming gear and quiet systems.

For more information visit bequiet.com.

Available at:

scan.co.uk · aria.co.uk · ebuyer.com · overclockers.co.uk · novatech.co.uk · amazon.co.uk

be quiet!®



Curse of Monkey Island was the last LucasArts game built in SCUMM

RICK LANE / THE ENGINE ROOM

SCUMM

Rick Lane speaks to SCUMM lord Aric Wilmunder about the definitive adventure game technology behind Monkey Island and Day of the Tentacle

Does SCUMM need any introduction? The Script Creation Utility for Maniac Mansion became the basis for all but two of LucasArts' adventure games, including The Secret of Monkey Island, Day of the Tentacle, Sam and Max Hit the Road and Full Throttle. During its 12-year existence, SCUMM's 2D side-scrolling graphics and verb-based interface established the basic framework for the adventure gaming genre, variations of which are still used by many adventure games today.

SCUMM was a constant presence during LucasArts' golden years, so much so that its importance wasn't always recognised, and during its later years, the tech was rather taken for granted as prettier technology danced before the

studio's eyes. But what made SCUMM so enduring within the studio? How exactly did it function, and in what ways did it help LucasArts' developers to create their games?

To find out, we spoke to the man who kept SCUMM afloat during the entirety of its lifespan at LucasArts. Aric Wilmunder was manager of software tools and technology at LucasArts between 1985 and 2000. He was involved in SCUMM's original coding, and supported and updated the engine right through to when LucasArts switched to the GrimE engine for Grim Fandango in 1998.

First programmed in 1987, SCUMM emerged from the combined efforts of Wilmunder, Ron Gilbert, creator of Maniac Mansion and Monkey Island, and Chip Morningstar, co-creator of

the prototypical MMO Habitat along with Wilmunder. SCUMM was initially conceived as a scripting language designed to make game development quicker and easier.

'A tremendous amount clearly had to do with Ron Gilbert,' Wilmunder says. 'One of the ways Ron taught himself about programming was by taking apart other people's code, so a certain amount of the foundation of SCUMM and the language came from the fact that Ron had cut his teeth on developing extensions to the BASIC computer language that, I think, came out with the Commodore 64.'

SCUMM is what's known as a 'tokenised' language, where instead of script commands being defined by complex explanations, they're simply defined by a single-byte



Indiana Jones and the Fate of Atlantis was one of several games updated with a full voicetrack on CD-ROM



Sam and Max Hit the Road reworked SCUMM's famous interaction system, binding all interactions to the mouse cursor

fairly small number of pre-set commands. 'In the case of SCUMM, there were around 120 commands we had in the language. So you'd have a command such as "Walk Actor X to location Y",' Wilmunder says. The location to which an actor would walk could then be defined by several variables, such as an object on the screen or a specific X, Y location. Other SCUMM commands included 'Break', which stopped execution of a script for a single frame, and 'Wait For', which let SCUMM run multiple scripts simultaneously, commanding certain scripts to 'Wait For' other scripts when the game required.

Easy SCUMM, easy go

From a scripting perspective, coding with SCUMM was exceptionally easy, and it had the additional benefit of making prototyping speedy. In fact, LucasArts designers could go from concept art to a complete walkthrough of a game's basic layout in a matter of days. 'It was sometimes humorous because we would take game characters from previous games.

'For example, when we were developing Full Throttle, we didn't have an animated version of Ben Throttle, so we would take Indiana Jones,' Wilmunder laughs. 'It allowed the scripters to move quickly and not be held up by the animation efforts.'

Alongside its efficiency on the development side, SCUMM was also an efficient user of memory. 'It was probably one of the very first multi-tasking languages,' Wilmunder says. Game scripts were attached to specific rooms within the game world. For example, rooms would have an 'Enter' script that set up the room's animations, sounds and objects – any part from a character exclusive to the room, to an object such as a ticking clock. 'The other benefit of these room entry and exit scripts was that, as soon as you walked out of that room, that script would go away; that clock would effectively cease to exist, and no other part of the system had to be aware of it,' Wilmunder adds.

Structuring the technology in this way was hugely beneficial when working with limited memory, as

value. 'If you have a language that only has 200 commands, you can turn all those individual commands into these individual tokens,' Wilmunder explains. 'As it turned out, on the Commodore 64, Commodore was only using a limited number of tokens, so the work that Ron did involved adding new tokens and new commands to the language.'

Although the team was designing games for the Commodore 64, it did the work on SUN workstations – modular computers designed by Stanford University in the early 1980s. To program SCUMM, the LucasArts team created several tools

on the SUN workstations that would then communicate with the Commodore 64 with a ribbon cable.

'Effectively, we had access to tools that many other developers, who would only use Commodore 64s as their primary development tools, wouldn't necessarily be able to access,' Wilmunder says. 'So initially, Ron and Chip went through, they defined what the commands that were going to be inside the SCUMM language and, by passing them through this system, they ended up with tokenised output.'

The advantages of this tokenised approach are numerous. Firstly, it means the language is limited to a

was the case during SCUMM's early years. SCUMM was also extremely easy to debug because of its relatively small number of commands. 'If you have a byte that can hold 256 commands, but you're only using 120 of them, all you had to do was put in a very simple test to say, "Hey, if I'm executing something that's not in these 120 commands, something's wrong. Let me know about it."'

But SCUMM was more than just a scripting language, although giving it a precise definition requires a little explanation. It wasn't a game engine like we're used to seeing today – a fully integrated game-making utility such as Unreal or Unity. Instead, it comprised a series of individual tools, some of which were developed by LucasArts, while others were third-party tools. Wilmunder refers to these tools collectively as the SCUMM 'system'.

The 'Guy Brush'

Scripting in SCUMM was performed with off-the-shelf text editors, while characters were drawn with DPaint. With this setup, it was possible to create 'brushes' that enabled artists to paint a drawn image multiple times on a background.

In fact, when the protagonist for *The Secret of Monkey Island* was drawn for testing, he didn't have a name, so the artist simply named the character brush 'Guy'. During testing, the developers ended up referring to him as the Guy Brush. "Then we needed a name for the character, and we kind of looked at each other and somebody said, "Well, why don't we just call him Guybrush?"' Wilmunder says.

Although the LucasArts team used some off-the-shelf tools for SCUMM, most of its tools were bespoke, and named in typical LucasArts fashion. Themed around bodily fluids, the script interpreter was named SPUTM. Likewise, its first animation system was known as BYLE, and when it was updated for *Day of the Tentacle*, it was renamed CYST. LucasArts also developed an object marker for defining different art objects in its various animation states called FLEM, and a tool that compressed completed artwork,



For Day of the Tentacle, Wilmunder rewrote the animation system so that the developers could create bigger animations

animation and so on into an RU file, which was called MMUCUS.

SCUMM employed two other file types during the development process. SCU files were script files, and LFL (LucasFilm Limited) files were room files. "When you took an entire game, and you looked at it from the developer's side, there would be one file that was the directory of all these pieces, and then everything beyond that was each room being an LFL file. So you'd see all these individual LFL files, and then when we finally shipped the game, we'd take all the LFL files and bundle them all up into one single file," Wilmunder says.

Walk to Monkey Island

This is essentially how SCUMM functioned, and how the developers used it behind the scenes. But what about its most famous feature, the verb-based interface? Although this interface debuted in *Maniac Mansion*, it was initially designed for an earlier game that was never made. That game was *I Was a Teenage Lobot*, set on a space station

where criminals were punished by having their brains removed and placed in the bodies of station-serving robots.

Wrongfully convicted of a crime, your character has his brain placed inside a shoe-buffing robot, and must reunite with his body before it's incinerated. 'A shoebot could say very simple phrases, such as "Polish your shoes, sir?" or "Could you let me through this door?" – very simple commands, so the interface had to be simplified', Wilmunder points out. This situation formed the basis of the interface that eventually found its way into *Maniac Mansion*, and almost every other LucasArts adventure game after that.

What's interesting about this interface is that it isn't an overlay, an additional part of the game developed separately from the rest. It was coded directly into SCUMM. 'SCUMM knew two worlds,' Wilmunder says. 'SCUMM knew that line you typically saw on the screen with the view of the room or the view of the world above it, but it also knew the screen below it.' In other words, SCUMM could tell whether players were clicking on the game world or the verb interface, and would interpret the click differently, seeking out objects or X,Y locations in the game world, or the appropriate verb in the interface.

SCUMM was in constant use over a 12-year period, and during that time, computing technology advanced enormously. To give you some context, upon its release *Maniac*

Monkey Island 2 introduced the IMUSE audio system, designed to synchronise the game's music with on-screen action





Mansion was one of the most advanced games of its time. 'Maniac Mansion on the IBM PC supported five different graphics modes,' Wilmunder emphasises. 'So it supported black and white, CGA four-colour mode, 16-colour Tandy graphics, 16-colour EGA graphics and 16 colours in a 256-colour mode. And at the same time, it supported the PC internal speaker, and I think it also supported a sound card.'

The GrimE is ripe

Over its lifetime, SCUMM was constantly updated. Maniac Mansion ran at a native resolution of 320 x 200, while the Curse of Monkey Island, the last LucasArts SCUMM game, ran at 640 x 480. Monkey Island also improved SCUMM's interface over Maniac Mansion, including the addition of a dialogue tree. Other updates included the addition of the IMUSE audio system in Monkey Island 2: LeChuck's Revenge, which synchronised the game's music with on-screen action, smoothly changing between scenes, and a rework of SCUMM's famous interaction system in Sam and Max Hit the Road, which bound all interactions to the mouse cursor.

SCUMM also saw the shift from floppy disk to CD-ROM, a transition that was comparatively easy for LucasArts because of the way SCUMM packaged its LFL files. 'On a CD-ROM, especially in the early days, going from one place of a CD to the other could take between 400 and 800 milliseconds,' Wilmunder says. 'So, some of the benefits came from the fact that we had already pre-packaged all these rooms together. It meant that the room, the animations and the sounds were already bundled tightly together anyway.'

In the early 1990s, games such as LOOM and Indiana Jones and the Fate of Atlantis saw rereleases

because of technological innovations such as the switch to CD-ROM, which allowed for full voice acting, and visual upgrades from 16-colour to 256-colour art.

Yet for all these changes, the fundamental scripting language that was the essence of SCUMM barely altered at all. In fact, Wilmunder says that if you looked at '90 per cent of the language that was in Maniac, you could probably see the language that was in Curse of Monkey Island and say, "Yeah that's the same Walk Actor command."

As time went on, however, SCUMM was increasingly seen as restricting the company's ambition on account of it being designed to do a specific job. 'One of the project managers at one point described SCUMM as "trying to push an elephant with a pencil eraser" and I don't know entirely what he meant,' Wilmunder jokes. The first development team for The Dig coded the game in a brand-new engine, but after the lead developer left the project shortly after that engine work was completed, the game's assets were ported into SCUMM.

Eventually, SCUMM was abandoned in favour of GrimE, which formed the basis for Grim Fandango and Escape From Monkey Island, LucasArts' final adventure games. Interestingly, Wilmunder

SCUMM was built specifically for Maniac Mansion. The clue is in the name

insists that SCUMM could have been adapted into a 3D engine. 'I was a little disappointed that Grim Fandango built a new engine because, when I look at the game, the key difference I see is that you could have put a 3D animation system on top of SCUMM, and built the same product,' Wilmunder says. 'But I think there was also interest on the designers' part to see where they could go with a new system.'

The Curse of Monkey Island wasn't quite the end for the SCUMM system though. In fact, there's a whole alternate history of SCUMM that rarely gets any attention. Ron Gilbert left LucasArts in 1992, and founded Humongous Entertainment, producing kids' games, sports games among other game types. Gilbert licensed SCUMM – the engine he had co-created – from LucasArts, using it to create games such as the Putt-Putt series and Spry Fox. The very last SCUMM game was released in 2001. It was called Pajama Sam: Games to Play on Any Day.

Gilbert's work at Humongous emphasises that SCUMM had flexibility, which LucasArts never fully explored from an artistic perspective, despite making some great games. On the technical side, however, it's that exact flexibility, that ability for SCUMM to evolve and adapt, that Wilmunder remembers above all else.

'What was wonderful about working on SCUMM and the tools was that every year, every game there was something new that we were going to be doing. I remember at times people would often ask me, what was my favourite SCUMM game? And I quickly realised that my favourite SCUMM game was always the one we were working on right then, because there was some aspect of it that was going to move up the standard.' **CPC**

Monkey Island improved SCUMM's interface over Maniac Mansion, including adding a dialogue tree



GAMING

ARCHAEOLOGY

Cancelled games are usually kept under lock and key, while copyright laws prevent museums and online archives from providing access to old games. Sam Batten asks how we can preserve our full gaming heritage for future generations

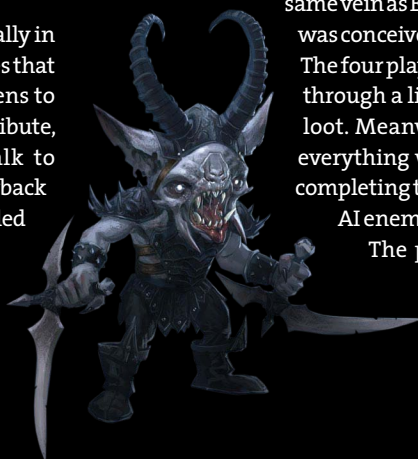
Somewhere in the dark recesses of your brain, you might have heard of *Deus Ex: Insurrection*, *Shadow Realms* and *Mission to Nexus Prime*, but you'll have never played them. Welcome to the world of gaming archaeology, dedicated to curating the growing archive of cancelled games, and preserving the games of yesteryear.

It's no big news that games get cancelled, especially in today's saturated gaming market, but how do games that seem to disappear get preserved, and what happens to them? At www.unseen64.net, a site to which I contribute, we collect design and concept documents, talk to developers and use tools such as the Internet Wayback machine to collect as much information about cancelled games as possible.

Shadow Realms

Let's start by taking a look at some of the cancelled games themselves, kicking off with *Shadow Realms*,

A *Shadow Realms* creature concept



an online action RPG developed by BioWare Austin that was due for release in autumn 2015. The game's cancellation was only announced on 9 February, 2015, but thanks to some anonymous insider information sent to www.unseen64.net, we saw some details about the game.

Shadow realms was set to be a 4-v-1 online game in the same vein as *Evolve*, although our insider says the concept was conceived long before the announcement of *Evolve*. The four players would be heroes that worked their way through a linear map, killing enemies and looking for loot. Meanwhile, the player on their own would do everything within their power to stop the four heroes completing their objective by setting traps, summoning AI enemies or attacking the heroes directly.

The player-controlled characters would have been completely customisable, so you could design your hero exactly how you wanted, and the game world was set to be Earth itself, but being invaded by

creatures such as werewolves, wraiths and zombies. The insider also stated that rejected monster designs from Dragon Age: Inquisition were to be used, invading from a parallel world called Embra. BioWare Austin wanted the game to have a Gothic but modern feel, giving players access to modern gear such as hoodies, as well as medieval-style armour and swords.

Also, when BioWare Austin showed the game to the other BioWare offices, our inside source said it had a lukewarm reception, with most of the offices being more excited about having a new IP on which to work than the actual game. To make matters worse, the feedback from players and critics at Gamescom 2014 was mostly negative.

According to our source, all this negativity ultimately made publisher EA nervous, and it began to lose confidence in the project. Then, in January 2015, many of the developers were moved to other projects such as Star Wars games and Dragon Age add-ons, leading to departures from the company. This happened despite Shadow Realms being very far through its development process, showing that publishers aren't afraid to cancel games at any stage of development if they think they won't be successful.

Deus Ex: Insurrection

There's one game developer, though, who is trying to keep his hard work on cancelled games preserved, and available to the public – Warren Spector. He's famously known for being the director and a major driving force behind the popular Deus Ex series and, most importantly, his preserved work includes creative documents on Deus Ex: Insurrection.

Deus Ex: Insurrection isn't Human Revolution, which was created by an entirely different studio, but a game designed by the original game's developer Ion Storm, with a programmer from the original game, Art Min, leading the project. The game was only ever conceptualised on paper, and little to none of it was ever designed on a machine. Most publishers would file this type of information away from public eyes, but conversely, Spector has allowed us to learn a great amount about what Ion Storm wanted to create.

The documents describe a high-concept game based in 2027, with five world superpowers that would either rise or fall depending on the intelligence you gave them. Insurrection would take place 20 years before the events of the original Deus Ex, and you would play Blake Denton, the father of JC Denton from the first game. You could take many avenues during the game, and the fate of the world would be made by your choices. The game would also be open-ended, possibly with multiple outcomes depending on your in-game decisions.

The concept document also goes into what the Insurrection team thought were the failings of the previous title, Invisible War, and why Insurrection would surpass it, which are as follows:

- The action shooter elements didn't live up to the experience of mainstream shooter games.
- There was too much dialogue interrupting the game, resulting in slower-paced gameplay.



Shadow Realms graveyard battle concept art

■ The story wasn't clear enough for players to get a clear direction.

■ The game wasn't accessible enough to the mass market. The user interface and the weapon/biomod inventory selection was too cluttered.

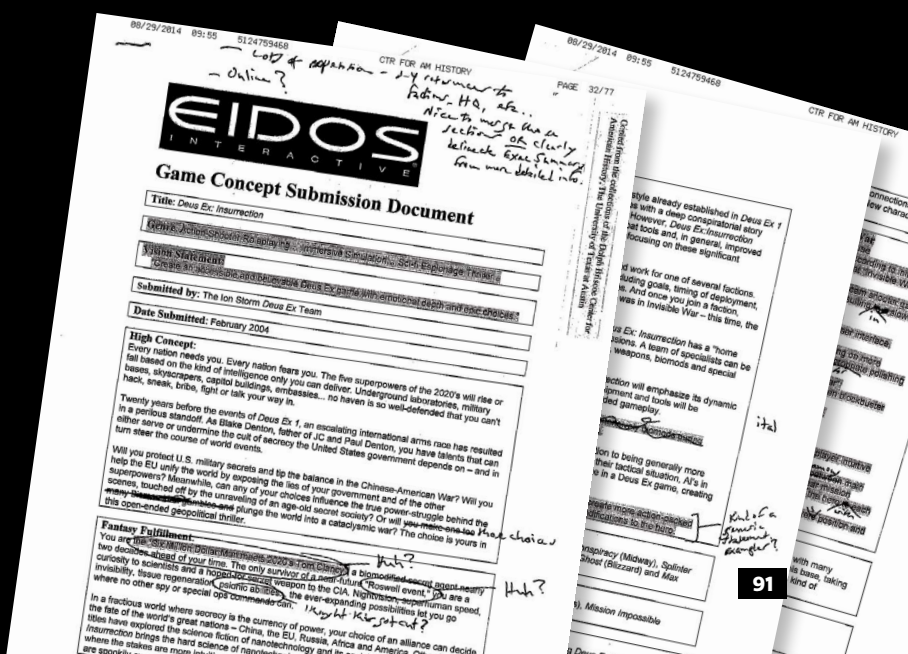
Art Min said Insurrection came to an end when Spector, founder of the company and director of the first two games, left Ion Storm in 2004. Min left shortly afterwards, and the two of them founded Junction Point Studios together in 2005. You can read the whole concept document for yourself on www.unseen64.net

Preserving cancelled games

Warren Spector made his concept documents publicly available by archiving them at the Dolph Briscoe Centre for American History, at the University of Texas. This centre controls the UT Video Game archive (<http://tinyurl.com/UTVideoGame>), and its mission is simple: 'To preserve and protect the work of video game developers, publishers and artists for use by a wide array of researchers.' The archive is completely free to access, and is a goldmine of concept documents and other resources from video game development – it's a shining example of how we can preserve information from the source.

There's also the Computerspielemuseum in Germany, which has amassed a huge amount of games and exhibits over the past four years. The museum and its creator, Andreas Lange, along with other institutions in Europe, are lobbying to get stringent laws in place to help protect

Warren Spector made the concept documents for Deus Ex: Insurrection publicly available



the preservation of games, and in 2014, founded the European Federation of Game Archives, Museums and Preservation Projects. Its goal, in addition to lobbying and the distribution of knowledge, is to establish preservation and description standards.

Andreas believes that game developers and publishers don't do enough to preserve their work, and that the largest amount of preservation work is done by the gaming community, but only a certain amount can be achieved without help from the publishers. Every now and then, you get some juicy information about a cancelled game, such as the details about Shadow Realms and Deus Ex: Insurrection, but usually, attempts to get information about cancelled games sees you confronted with a big stone wall.

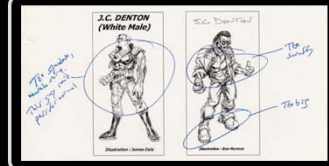
The problem with non-disclosure agreements

So why is it so hard to dig out information about cancelled games? Let's start by looking at NDAs (non-disclosure agreements), which many game developers are required to sign before starting development on a game. The idea is that you won't divulge any information about the game to the press, or anyone else outside the development team for that matter, so the best-kept secrets and features of a new game can be kept away from competing publishers, and retained as surprises for the player. Information is slowly dripped out so that publishers can talk about the new features with gamers, but if a game gets cancelled, the developers are still under NDA.

Assuch, Unseen64 has found that many game developers are unable to share any knowledge about cancelled games on which they've worked, or if they can, they don't want their name mentioned.

Since they're under NDA, there's a genuine worry that this sharing of information will result in them not being able to work in the industry again. As a case in point, I was recently in contact with a developer who worked on a cancelled Earthworm Jim PSP title, who said, 'I'm fine with answering your questions. For safety, I'd prefer not to be credited in any way.'

On many occasions, publishers have asked our site to remove images of games, or certain details about



:: Mission

:: Researchers
:: Finding Aids

:: Support

:: Donors

:: Media

:: Blog

:: Contact

All Media

184 items



"Ultima VII: The...



"Ultima VII: The...



"Akalabeth: World...



"Beyond Adventure...



Reel Cheap /...



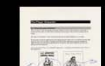
Reel Cheap /...



"Disciples Intro"...



Shooter Story 3...



The Player...



"Wingleader"...



Castle of Lord...



Deus Ex [box...



[Futuristic soldier...



TriadRedArrow ...



Wing Commander...



System Shock...

next

Finding Items Digital Media Repository

The UT Video Game archive is free to access, and is a goldmine of concept documents

Star Wars Galaxies players filed a lawsuit against Sony to prevent it from shutting down the servers

them, and we've had no choice but to oblige – we're a non-profit site, and we can't afford to face off against a large corporation's lawyers.

So why are so many publishers scared about people finding out what happened to their cancelled games? There's an aspect of publishers wanting to protect their reputations, especially when some games end up getting cancelled for dubious reasons. A publisher may also want to revisit ideas from a cancelled game in a future game, and it may be important to keep those ideas under wraps.

There's also a case to be made for preserving the ideas surrounding cancelled games, though, and making them public, but heavy-handed non-disclosure agreements effectively block this from happening. If a game was cancelled because it wasn't good enough to be released, or if the project later moved in a different direction, leaving old ideas behind, then the old information could be preserved. Other game developers could then learn from the previous developer's mistakes, or evolve an idea that didn't work for the original developer.

A recent example is the cancellation of Silent Hills. Konami cancelled the game for unknown reasons, the playable teaser demo has been removed from the PlayStation Network and, even if you previously downloaded it, you won't be able to do so again. The only place this game can be played is on the consoles of people who downloaded it but didn't delete it. It's otherwise been erased, with no opportunity for gamers to get a glimpse of what could have been, or for other developers to learn from those mistakes.

Preserving retro games

Getting developers to talk about cancelled games isn't the only problem with preserving games though. What about games that came out in your childhood that you played



and loved? What can be done to make sure that, in generations to come, you can go back and enjoy these games? In theory, of course, you could buy an old PC on eBay, and a stack of old games on floppy disk or CD-ROM, and play them on an old machine. But floppy disks degrade quickly, and CDs get scratched – many from the old days simply don't work any more.

Some Steam titles also use DOSBox to emulate old games, while Good Old Games enables you to purchase digital copies of games, readily patched with open source emulation and compatibility software such as DOSBox and ScummVM. Good Old Games has also made deals with major publishers, allowing it to sell older games from companies such as Ubisoft and Disney Interactive. But many older games aren't available on these sites.

For this reason, some people have started preserving old games in playable form online. For example, the Internet Archive has preserved thousands of old games on its website, allowing you to play many old titles from yesteryear in your browser, and its collection of DOS games at <http://tinyurl.com/DOSArchive> is incredible.

But such archives are under threat from copyright law, particularly section 1201 of the Digital Millennium Copyright Act in the USA, which states that: 'No person shall circumvent a technological measure that effectively controls access to a work protected under this title. The prohibition contained in the preceding sentences shall take effect at the end of the 2-year period beginning on the date of the enactment of this chapter.'

Essentially, this US copyright law prevents anyone from circumventing access controls and technical protection measures in a copyrighted system, which is required when ripping games from their original media to make them available for people to download illegally. It may help to prevent piracy, but this blanket law also restricts the preservation of old games.

The EFF (Electronic Frontier Foundation) has criticised this blanket approach and says it will be historically damaging. On the organisation's website, Mitch Stoltz, one of the lead lawyers from the EFF, says that 'thanks to server shutdowns, and legal uncertainty created by Section 1201 ... objects of study and preservation may be reduced to the digital equivalent of crumbling papyrus in as little as a year'. The EFF has called for there to be at least an exception to the rule, for museums and research organisations such as the Internet Archive.

'Every three years, the Copyright Office holds a "rulemaking" process, where people can propose exemptions to the broad ban on circumventing DRM, although not the ban on selling circumvention devices,' says Stoltz. 'In this year's rulemaking, the EFF proposed exemptions for restoring video games after their servers have been shut down, as well as exemptions for using video clips from DVDs and online streaming services, jailbreaking phones and other mobile devices, and modification or



There are loads of playable DOS games on the Internet Archive

In 2012, NCSoft announced it was shutting down City of Heroes completely

TALKING POINT

Should there be exemptions in copyright law, so you can play old games at museums and on online archives? Should more publishers open up their archives about cancelled games, so we can learn about them from a historical perspective? Let us know your thoughts at: letters@custompcmag.org.uk

research on vehicle electronics. We've submitted a lot of evidence showing why the Copyright Office should grant these exemptions. We expect it to decide by the end of this year.'

In Stoltz's opinion, 'section 1201 is often used by the entertainment industries not to prevent copyright infringement, but to control markets and lock out competition'. The EFF is moving to help in the work of preservation, and Stoltz is hopeful that the aforementioned exemption for museums and archives will be passed. Stoltz believes that if the exemption isn't passed, then museums that follow the law exactly will end up with huge holes in their exhibits, being unable to give a full picture of the history of gaming.

Section 1201 also restricts players from continuing to play an MMO game once its servers have been taken down by publishers, and prevents players from using their own servers from hosting the game. City of Heroes was a hugely popular MMO in 2004, winning numerous awards in the same year. It had a huge player base, which dwindled as the years went on, but there were still thousands of players faithfully playing it, who had invested hundreds of hours in the game and their characters. Then, in 2012, NCSoft announced it was shutting down the game completely.

Recently, however, gamers have started taking matters into their own hands. Star Wars Galaxies players filed a class action lawsuit against Sony in 2011 to prevent it from shutting down the game's servers. EA has also been taken to court over the length of time it supports certain sports games online, and it lost.

Attitudes towards the preservation of games are seemingly changing and, with so many gamers feeling passionate about it, we'll hopefully be able to preserve our gaming heritage, including cancelled games and old games, for generations to come. **GPG**



GARETH HALFACREE'S

Hobby tech

The latest tips, tricks and news in the world of computer hobbyism, from Raspberry Pi, Arduino and Android to retro computing

REVIEW

Velleman 3D Printing Pen

Three-dimensional printers are a big deal at the moment, with every technology company – including outfits such as Arduino, better known for low-cost educational microcontrollers – looking to stick their fingers in the pie. There's no doubt that they're handy devices, but they're still prohibitively expensive; even the cheapest hobby model imported from China will set you back at least £300, and building your own 3D printer – while possible – is technical and fiddly.

There's a gap in the market, then, for an absolute entry-level device – and it's a gap that toolmaker Velleman is looking to fill with its 3D printing pen.

It isn't the first such device, of course – 3Doodler, from the wonderfully named WobbleWorks, hit Kickstarter back in 2013 with the exact same concept and walked away with a cool \$2.3 million – minus fees, of course – for its trouble.

The overall concept of the two pens is identical: take the printing head out of a 3D printer and make it handheld, replacing all those expensive motors and controllers with cheap muscles and brainpower.

You're then left with a bulky pen that only has a little more to it than a glue gun: a nozzle at the end heats up, while a motor – an upgrade from the squeeze-to-dispense friction mechanism of most glue guns – pushes through PLA filament, the same material used in most 3D printers.

The result is a thin stream of soft plastic that hardens as it cools, creating a physical 'drawing' that isn't constrained to the usual two dimensions of a traditional pen or pencil.

If that sounds unbelievably useful then it's time to read the results of my testing before getting out your credit card and placing an order. The real magic of a 3D printer is

twofold – it can create complex objects on demand and identically each time and it can create said objects without direct human interaction. Take the extrusion head out of the printer and hold it in your hand, and you remove both these advantages.

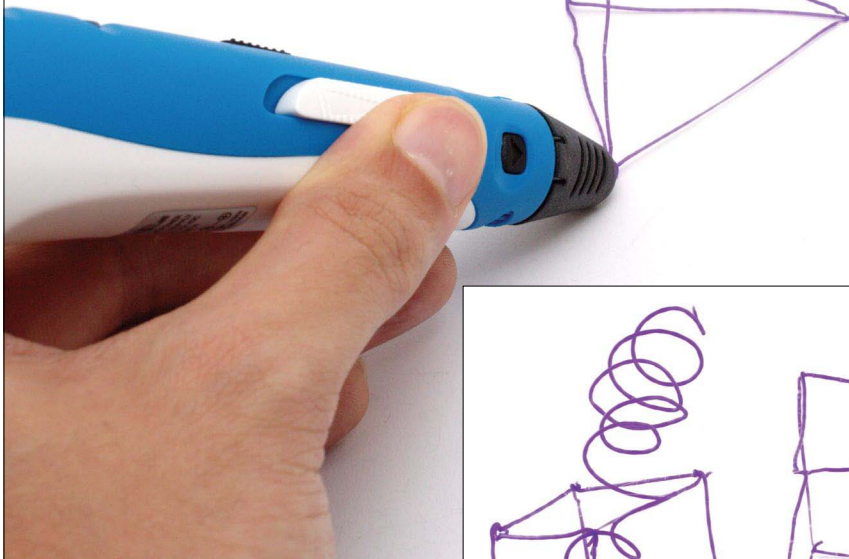
Suddenly, you have to spend every minute of the printing process actively controlling the pen, and your pathetic meat-and-bone nature means that the end result is wobbly and inaccurate.

At least, that was my experience. I'd be the first to admit that I don't have a great deal of artistic talent, but only part of the horror of what I created can be blamed on that. The



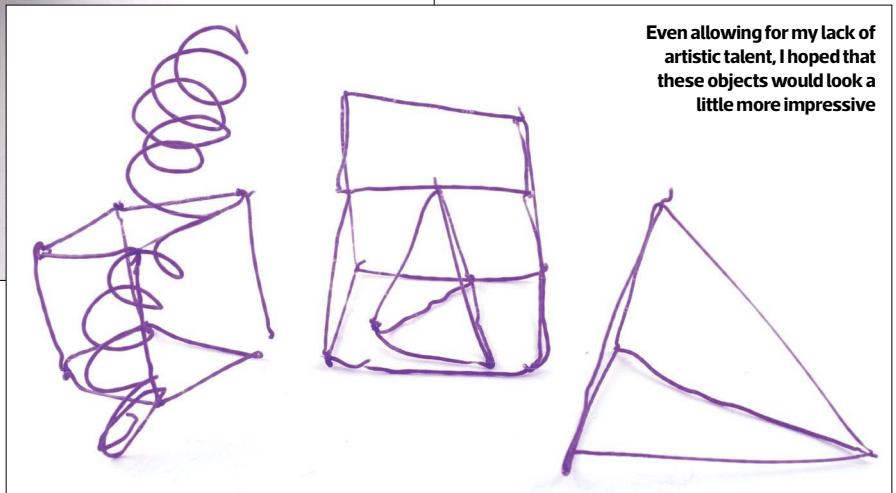
**Velleman's 3D
Printing Pen costs just
£64.79 inc VAT**

Yes, technically it works, but don't expect to replicate the Eiffel Tower, regardless of what's shown on the box



The result is a thin stream of soft plastic that hardens as it cools, creating a physical 'drawing'

Even allowing for my lack of artistic talent, I hoped that these objects would look a little more impressive



technology behind a 3D printer simply doesn't translate well to human use. Without the motors and controllers, the movement is inaccurate and the print is wobbly; without a heated print bed, the materials solidify when you don't want them too – or, in many cases, stay too soft to create a structure such as the impressive scale model of the Eiffel Tower promised on the back of the packaging.

The pen's controls, too, are clumsy. One side holds two buttons, the lower of which activates the motor to extrude the PLA filament. The speed at which the filament is extruded is controlled by a slider on the other side of the pen, but it has a hair-trigger. I found the ideal speed to be less than a fifth into the slider's travel, and just 1mm above that mark accelerated the speed to the point where the pen was unusable. Given how you hold a pen, it was all too easy to knock the speed control – which has no locking mechanism – during use.

When a 3D printer prints objects, it does so in a complex computer-generated pattern of support structures to keep the structure upright. A human can't easily reproduce that system: attempts to create freestanding structures, as with my wobbly cubes and pyramids, are exercises in frustration, involving lots of pausing and blowing while waiting for struts to cool enough to support their own weight, as the pen threatens to stretch the filament out of shape. Slightly more success can be had by using the pen to create more solid surfaces, but you'll soon burn through the bundled PLA and the finished article won't be the attractive, precise

creation you imagine when the topic of 3D printing comes to mind.

What the Velleman 3D Printing Pen does have going for it is its price: at £64.79 inc VAT, it's a fraction of the cost of a real 3D printer. The manual's warning that it is for 'educational use only' rings true, however – I can't recommend picking one up as anything other than a curiosity. If you do, and you actually manage to use it for something practical, let me know – I'd be fascinated to know the how and why!

The Velleman 3D Printing Pen is available now from <http://cpc.farnell.com>, order code MK00232.



The speed control slider is extremely sensitive, and maxes out a fraction of the way into its travel



REVIEW

Liverpool MakeFest 2015

The big event of this past month was Liverpool MakeFest, the first of what promises to be an annual event for the Merseyside area based loosely on the Maker Faire format. Having got up at an ungodly time of day to get there in time, I found my way to Liverpool's Central Library to find out what was going on.

'It's a fun, free, family festival of everything "makey", so it's science, technology, engineering and creative arts all coming together, and looking at how they're shaping our world,' explains Mark Feltham, who had been working with partner Caroline Keep since February to organise the event.

'Along with a lot of pop-culture based ideas, such as making Daleks, and anything people really want to see in physical form,' adds Keep, taking a break from the event at the Library entrance.

'Fabrication, cheap fabrication, design thinking and fast prototyping has made that possible now, so we wanted to get a lot of people involved so they could see there are places you could go to, such as DoES Liverpool, our makerspace here, and you can come here, and there are various locations across Liverpool in which you can work and get involved in making.'

The call went out to the maker community, and by gosh was it answered. 'All of the maker community decided to come together and say, "Yeah, actually, we want to do a stall for you," and everybody flocked in,'



With over 1,000 people through the door on day one, the first Liverpool MakeFest was a stunning success

enthuses Keep. 'We thought we'd get maybe 30 stalls, but we've ended up with more like 60 or more!'

Initial figures suggested well in excess of 1,000 visitors on the event's first day, which isn't bad going considering the MakeFest lacks the branding and marketing budget of a Maker Faire. 'Everybody here has worked for free,' Keep explains. 'They've brought the resources for free, they've given their time for free and everybody has done everything for free to keep it a free event for Liverpool, so people could get involved.'

'Everyone' is a broad spectrum too. Walking through the entrance, you're immediately greeted by a full-scale Dalek, controlled via remote by a staff member, which guards a table of Dr Who-themed goodies from top-quality ring modulators for that true 'exterminate' timbre through to screen-quality masks and props. Stepping past the Dalek reveals the team from DoES Liverpool, the aforementioned makerspace, and its crowd-pleasing classic MFUKLC shooting gallery: an Arduino-controlled automatic scoring rig, set up in a small marquee, with a constant queue of visitors looking to chance their arm with the provided Nerf pistols.

'It started off with us thinking: "maybe we'll have a few stalls in the little children's library,"' Feltham laughs, 'and now we've got three floors and over 1,000 people in! There's a wide variety of ideas on display spread throughout the library.'

Taking the escalator up to the second floor, I find all sorts of people, including a lone maker showing off his Raspberry Pi-powered smart signage system to a company that makes remote-operated drone aircraft for the film and TV industries, as well as a company that specialises in Android application development and an author looking to sell copies of his latest book.

The Reading Room is where the real action can be found. Braving the crowds – and the heat, with the air conditioning nowhere near



The Dark Water Foundation's Lego-powered submersible ROV workshop was completely full



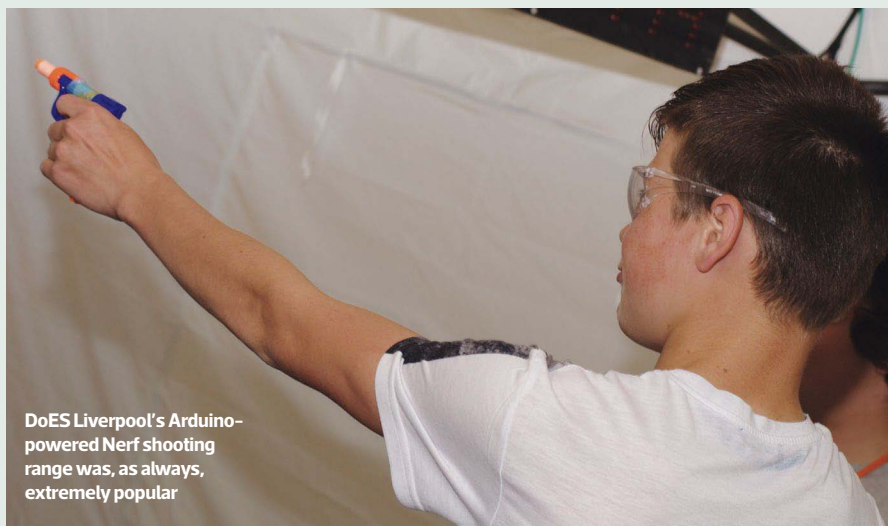
Dr Who fans attending got a real treat, thanks to a company making screen-quality masks



Ben Gray drew a crowd with his MeArm and new MeBrain controller boards



It wouldn't be a maker event if there weren't 3D printers churning out interesting objects



DoES Liverpool's Arduino-powered Nerf shooting range was, as always, extremely popular

up to the task of dealing with so many warm bodies – I found Ben Gray, whose MeArm robotic arm I covered back in Issue 133, showing off the very-nearly-final iteration of his upcoming MeBrain control board. A quick chat and a handshake later, and I was touring the remainder of the stalls: stacks of components at wholesale prices, a company producing educational robotic faces, mobile-operated racing robots, tactile electronics featuring fabric-based circuitboards and even a small bipedal robot – valued, the stallholder proudly explained, at several thousand pounds – dancing Gangnam Style with considerable aplomb.

Upstairs, on the Library's top floor, a busy workshop ran throughout the weekend, offering a chance to build interactive Arduino-powered artwork with the team from Edge Hill university, fiddle with remote-operated submersible vehicles based on Lego with the Dark Water Foundation, and even sew with the Liverpool Sewing Club.

The fact that I'm so far into my word count and still haven't mentioned half the

attractions should be a hint that the first Liverpool MakeFest was a huge success, and for anyone in or around the Merseyside area there's good news: Mark and Caroline are already working on the logistics of MakeFest 2016, which promises to be even bigger and better.

'We're quite lucky in some respects that Denise Jones has been stellar at the library,

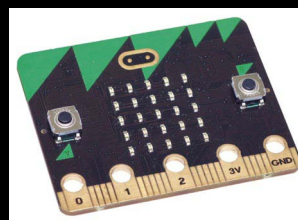
she's been phenomenal, and the library has really supported us with this,' a grateful Keep explains. 'So, in some respects, there were three founders, and we put together a board of makers when we realised it was going to be quite big, with key people who really know their stuff.'

More information is available at <http://lpoolmakefest.wordpress.com>

NEWS IN BRIEF

BBC reveals final micro:bit

The BBC has unveiled the finished design of the microcontroller board that will form the heart of its coding education programme in the coming years, and it's had a name change – the Micro Bit is now the micro:bit. Based on the mbed platform and powered by an ARM Cortex-M processor, the board has a 5x5 LED grid, accelerometer, magnetometer and Bluetooth radio, along with USB connections, two buttons and three GPIO pins. Approximately one million boards will be given out free to Year 7 pupils in the UK in October, after which the micro:bit will go on general sale and have its specifications released under an open source licence.



REVIEW

Circuitbeard Petduino

It's not every day that I get my hands on a device that acts as both a microcontroller platform and a kid's toy, but this month Matt Brailsford decided to break the pattern. Known in maker circles as 'Circuitbeard', Brailsford has been designing a virtual pet with which to gently steer the next generation of tinkerers.

Brailsford tells me that the prototype he's given to me is identical in most ways to the finished design, except that it's slightly bulkier and has the button assignments backwards. Designed as a standalone device that can be connected to a PC for programming, I supply power to the prototype and it loads the default sketch: a Tamagotchi-inspired virtual pet.

A face appears on the 8x8 LED grid that takes up the front of the laser-cut casing, and runs through various animation cycles – including 'talking', in which the mouth opens and a friendly buzz is emitted through a built-in piezoelectric speaker. The two buttons on the top edge can be used to interact with the creature, while the laser-cut plastic chassis includes various arms and ears that can be posed according to the owner's whim.

The outside is what will attract the kids, but it's the internals that are of real interest. The Petduino is based, as the name suggests, around an Arduino Nano clone, soldered to the rear of the board. The Arduino is entirely stock, which means complete compatibility with the usual Arduino IDE. A Petduino, in other words, isn't limited to being a kid's toy: its LED display can be used to show whatever you like, including graphs of its on-board



It may be cute, but the Petduino has a real goal in mind: getting kids into microcontroller coding

temperature and light sensors – you can expand on these sensors too, either manually or by using one of a planned series of add-on devices Brailsford has up his sleeve.

'I chose the "pet" concept, as I think it's a great way to get people emotionally attached to their device, and to not see it as just a bunch of electrical components, but beyond this concept, there's a lot more you can do with the Petduino than just using it as an interactive pet,' Brailsford told me when we were first discussing his project. 'I've built a handful of games such as Snake, Flappy Bird and a mini version of Dance Dance Revolution, as well as a bunch of musical instruments such as a sequencer and a Theremin, and I've even been playing with connecting a Petduino to the Internet so that it can respond and interact with a whole heap of other devices.'

Because the source code for all the above is available to users, the Petduino makes it easy



Two buttons may not seem like much, but it's enough to play simple games such as Flappy Bird and Snake



The Petduino includes laser-cut accessories, and you can quickly design your own

for beginners to get started. Even in its initial release, Brailsford has provided several personalities for the device – Robot, Rabbit, Mouse, Monster, Dog and Cat – along with examples for scrolling text, playing music and using the on-board sensors. The all-in-one design has another benefit too: you can get started as soon as the kit is built, and all the parts are guaranteed to be compatible.

The Petduino is clearly aimed more at the young and the young-at-heart than the hardcore hacker, but its low cost (Brailsford is aiming to get the final release version down to around £25-£30 inc VAT, plus postage) and attractive design mean it's likely to find plenty of interest from makers and educators alike. Add in the ability to design a custom virtual pet for your child – or yourself, let's be honest here – and I reckon Brailsford is going to be a very busy man when the orders start flooding in.

More information on the Petduino – including the ordering page, when the launch finally occurs – can be found on <http://circuitbeard.co.uk> **GPC**

NEWS IN BRIEF

HamShield smashes funding goal

An Arduino Shield with a radio transceiver that covers the amateur radio bands, the HamShield, has smashed its funding goal on Kickstarter. Created by Casey Halverson, the project sought \$25,000 to fund production of an add-on Arduino Shield, which could send and receive data on the common amateur radio bands: 136-170MHz, 200-260MHz and 400-520MHz. At the time of writing, it had raised an impressive \$48,000 with 21 days still to go. The boards are set to sell for \$99 excluding power supply and antenna (around £65 ex VAT).



Gareth Halfacree is the news reporter at www.bit-tech.net, and a keen computer hobbyist who likes to tinker with technology. [@ghalfacree](https://twitter.com/ghalfacree)



How 3D-printed rats could offer schools a vegetarian dissection

TECHNOLOGY

BUSINESS

SCIENCE

LIFE & CULTURE

THE FUTURE

alphr.com

A fresh take on technology



ANTONY LEATHER'S

Customised PC

Case mods, tools, techniques, water-cooling gear and everything to do with PC modding

Hands on with Hex Gear's R40

I wrote recently about a newcomer to the case market called Hex Gear, and this month I was sent the first retail final sample of its new micro-ATX case, the R40. As this month is stacked full of Dream PCs and new Skylake kit, we didn't quite get around to looking at it, but I've already built the case and I'm mightily impressed – we hope to do a full review soon. It's quite large for a micro-ATX case, but then so are most cases that are built with water cooling in mind. You can use a double 120mm-fan radiator in the roof, a triple 120mm-fan radiator in the base and there are custom mounts available for pumps and reservoirs too.

The case arrives flatpacked, and takes a couple of hours to assemble it, but Hex Gear has done an excellent job with the manual, so this process is straightforward. If you've built a Parvum case, it's on a similar but slightly more involved level, as there are numerous fascias, interlocking



The R40 arrives flatpacked, and takes a couple of hours to assemble it

sections and materials with which to contend. However, this system makes the case easy to customise, and the slide-off top and bottom panels are a great touch. The R40's best assets are its unique looks and excellent build quality, although you do have to fork out £200 inc VAT for the privilege.

Dream PCs uncut

This month saw one of our biggest Dream PC group tests ever, with over £50,000 worth of droolworthy,

customised rigs in our lab. Needless to say, testing them was both very quick, thanks to some extreme overlocks, but also quite draining due to the fact the temperature in our lab approached 30°C on some days in July, and that's before we fired up some of these 1,000W+ monsters.

So, what are my personal thoughts on this year's entries? I was actually massively impressed by the standard this year. Every PC had a unique offering, from Chillblast's custom Parvum case to the swoonworthy Overclockers Lian Li systems, Dino PC's stunning T.REX or Scan's epic paint-job efforts.

Every PC has a good amount of customisation so you can rest assured that, if you're lucky enough to be able to afford one, you'll get a gorgeous, unique PC.

External customisation was present on all the PCs this year. New entry Dino PC used a subtle vinyl wrap with a black scale effect, which looks really cool in the flesh and helped to break up the external boxy shape of the enormous Corsair Obsidian 900D, plus it looks fantastic inside. Meanwhile, both of Overclockers' systems were rather understated given their awesome hardware credentials and cooling systems, but the lighting effects, digital fan control panels and the 8Pack Supernova's



illuminated logo all helped to add to their stunning appeal.

Despite sporting some of the most extensive overlocks in the group test, both the Overclockers systems worked first time too, despite having travelled a couple of hundred miles to our lab. Even more impressive was Overclockers' work schedule – the company's machines arrived before anyone else's, so if I won the lottery this weekend and wanted a mega PC immediately, Overclockers would get the job done quickly and efficiently.

Meanwhile, Chillblast's effort went well beyond my expectations. The company has been a solid runner-up in previous years but this time it's raised the bar, paid attention to what's happening in the industry and come up with a PC that would draw plenty of attention if it had been made by a PC modder, never mind a company that also ships regular PCs. I particularly liked the fact that Chillblast had installed dust filters in the Parvum case – a feature that's usually missing if you buy a Parvum case off the shelf. It's also the smallest PC on test, but it still packs loads of power.

Hardware choices are always a sticking point with Dream PCs though. All our entrants went for Intel's X99 platform and, for the most part, the storage setups and overclocking settings were fairly similar. It was good to see Chillblast mixing it up with a micro-ATX motherboard, but the main question mark concerned GPUs. I spoke to a number of the manufacturers this year before the PCs were built and knew there would be a mix of GTX 980 Tis and Titan Xs.

The Titan X is the ultimate card for bragging rights, but the GTX 980 Ti is nearly as fast and considerably cheaper



However, there's only a small margin between the two cards in terms of performance, but a big margin in price, with the inevitable diminishing returns. The choice of graphics cards has been the difference between a win and a second place in the past too, as we saw with Yoyotech's Aurum 24K over a year ago. It opted for two Titans instead of three GTX 780s or 780 Tis and, as a result, it was more expensive but crucially also slower than Scan's 3XS Bear.

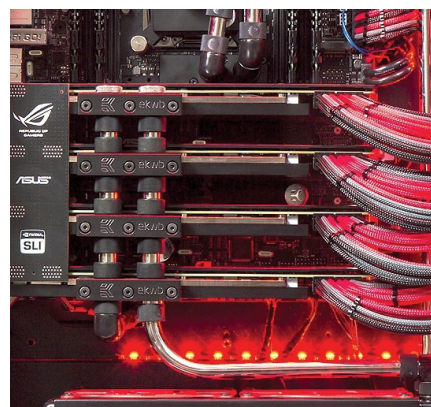
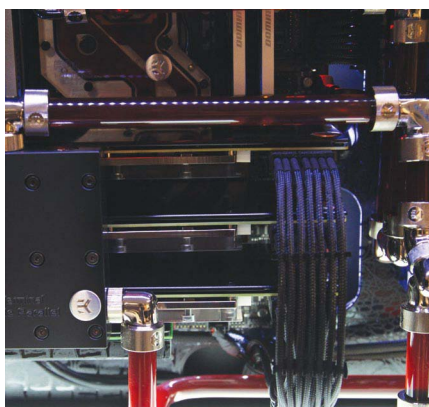
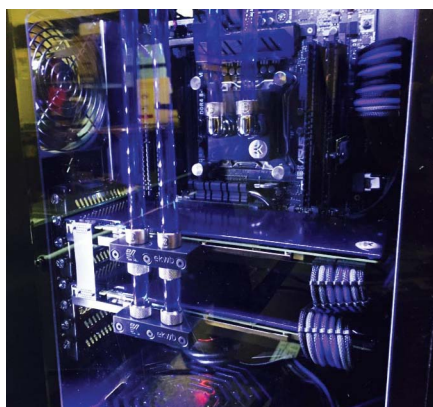
Some of this month's Dream PCs used Titan X setups, while others used GTX 980 Ti cards



I'm in two minds. On one hand, these machines are supposed to be Dream PCs, where money is no object. Overclockers also said that its customers usually go for the Titan X when they order systems such as the ones featured this month – after all, if you have that kind of money, you'll likely be wanting the absolute best, and that includes the best bragging rights too. Why have 980 Tis when you can have Titan Xs?

Of course, there's a strong argument to the other side of the coin too. The GTX 980 Ti is still a lustworthy product, and 980 Ti cards can usually be overclocked to near Titan X speeds. They're considerably cheaper as well – up to £250 cheaper, in fact, and when you're dealing with four GPUs in a single system, that's £1,000 more if you opt for the Titan X – our editor has already made his thoughts clear on this matter in a past column, saying how disappointed he'd have been if he'd splashed out on a Titan X given the GTX 980 Ti performs so close to it.

Personally, seeing as I'd need a lottery win to consider owning any of the dream PCs featured this month, I guess I probably wouldn't care either, although I suspect there would still be a value-conscious enthusiast inside me screaming 'don't do it!' In the end, though, we have to take every factor into account – not just the GPU choice. You can read all about this year's Dream PC entries on p40. **GPC**



How to

Give your case a polished metal finish

Want to make your PC's panels shine like mirrors? Antony Leather shows you how it's done

TOTAL PROJECT TIME / 48 HOURS

There's a good reason why some cases use chrome-covered plastic instead of real polished metal. Achieving a proper shine on metal surfaces is labour-intensive, and you also need to worry about oxidation. However, polished metal looks amazing, so despite the extra costs involved, many premium products such as waterblocks often sport mirror-like finishes.

It's possible to polish your case panels to a gorgeous sheen too, leaving you with gleaming surfaces that will make your PC stand out from the crowd. Be under no illusions though – this is hard work and will probably take several days, especially if you have no power tools to hand. However, drills and motorised polishers all come into play here to make the job easier – if you're a DIY fan or a car-detailing enthusiast, you'll likely have some tools in your arsenal to speed up the process.

TOOLS YOU'LL NEED



800, 1,000, 1,500 and 2,000-grit sandpaper /
Most hardware stores



Sanding block /
Most hardware stores



Autosol /
Most hardware stores



Motorised polisher and fittings /
www.amazon.co.uk



Drill bit buffing pad /
www.amazon.co.uk



Cutting compounds /
www.amazon.co.uk



1 / CHECK CASE FOR METAL COMPONENTS

Before you splash out on polishing compounds and tools, make sure your case has easily accessible metal panels that can be removed. Don't worry about whether they're painted, but avoid panels with multiple bends, as they'll make your job much harder.



2 / WORK OUT WHAT YOU WANT TO POLISH

You can polish your whole case or just a couple of key panels. For instance, we've chosen the front panel of our Phanteks case, but you can apply the same principles to side panels too.



3 / REMOVE METAL PARTS

Most metal panels come with plastic trimmings to hold them to the case. You'll need to remove these parts, as the polishing process can tarnish the plastic finish.



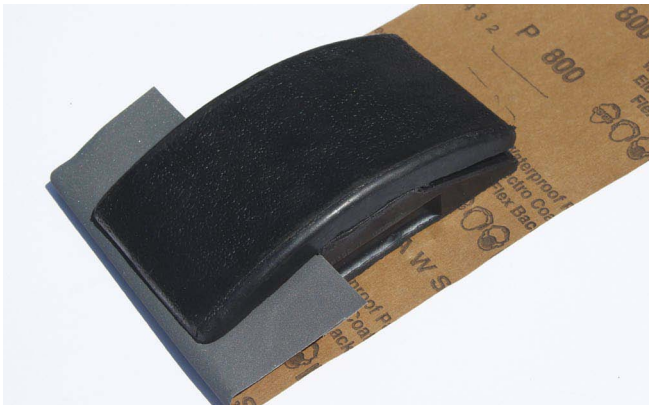
4 / SAND TO REMOVE PAINT

You'll need to remove any paint on the panels first, which is easily achieved by sanding them with 600–800-grit sandpaper. Don't be tempted to use any coarser paper, or you'll end up with a panel that's so scratched it will take days to polish properly.



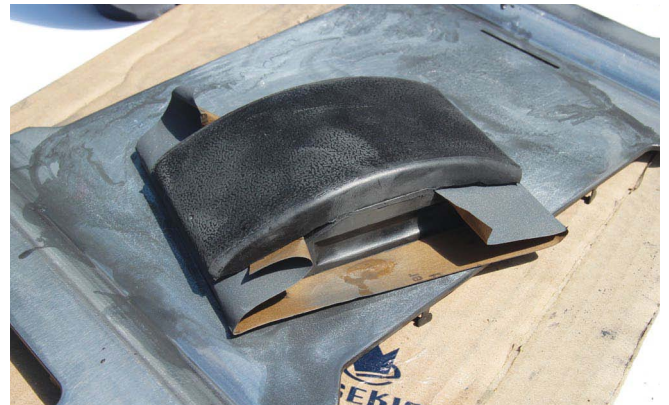
5 / WASH OFF PAINT RESIDUE

Wash off the residue from the paint and make sure all large areas are clear of it. Don't worry if there's any paint lurking in the corners – we'll deal with that in a minute.



6 / USE A SANDING BLOCK

If you're sanding manually, a sanding block will make your job much easier and won't tire your fingers as quickly. You can use it with any sandpaper by cutting it into strips. It's also quite heavy, so you don't need to apply much pressure when using finer-grit sandpapers.



7 / USE HIGHER-GRIT SANDPAPER AND WATER

Start with 1,000-grit sandpaper and work your way up to 2,000-grit, using a little water to create a grinding paste. You'll need to sand out all the small scratches in the panel. The higher, less coarse grit-numbers will eventually create a mild reflection.



8 / GET INTO THE CORNERS

There will likely be a little paint and some scratches in any corners, which you'll need to remove if you don't want to ruin the mirror finish at the end. Tear off some sandpaper and bend it to shape to enable you to sand right into these corners.



9 / USE ABRASIVE POLISH

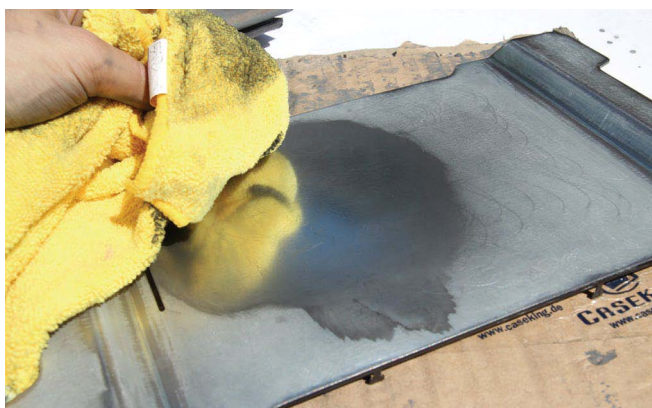
The final part of the manual process is to use an abrasive polishing paste such as Autosol, but tooth-whitening toothpastes work well too. Apply a small amount of the polish to a cloth.





10 / APPLY TO METAL

You'll probably see the surface begin to turn black, which is a sign that the polish is working. Continue to rub the cloth over the entire panel in circular motions, using firm pressure, and add more paste as required.



11 / BUFF TO A SHINE

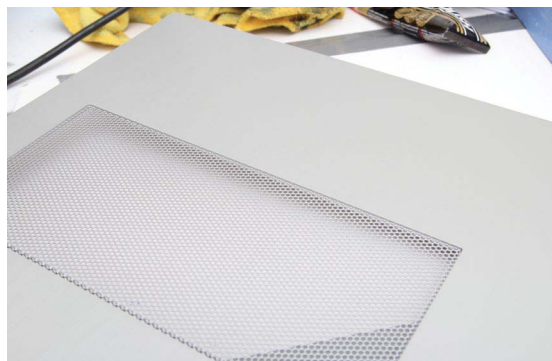
Every now and then, buff the paste so you can see the finish. Eventually you'll see the surface reflection becoming stronger and clearer. It will take some time but eventually you'll end up with a mirror finish, along with some stronger muscles.



12 / INSPECT IMPERFECTIONS

You can now spot areas that need work, so apply more paste and continue rubbing; you can't iron out imperfections once you've applied lacquer. If you're polishing manually, continue working hard at this process until you get a proper sheen, like the finish in step 23, then go to step 24.

POLISHING A NON-PAINTED SURFACE



1 / BARE METAL PANELS

If you have bare metal case panels, such as those on some Lian Li cases, your job will be a fair bit easier. They're paint-free and brushed to a fairly high standard already, meaning you just need to start with high-grit sandpaper.



2 / SAND USING HIGH-GRIT SANDPAPER

Start with 1,000-grit sandpaper, adding water to create a smooth sanding paste. Continue with this sandpaper until the brushed surface has been removed, then move on to higher-grit numbers.



3 / BUFF TO A SHINE

You'll eventually have a smooth surface, and can then move on to using Autosol as you would elsewhere in this guide. Apply it to a cloth and rub in circular motions, using more paste when needed.



13 / USING A MOTORISED POLISHER

Motorised polishers are popular with car detailing enthusiasts, and can make the job of polishing your panels much easier. They're essentially converted angle grinders that can be used with a variety of fittings.



14 / CLAMP OR FIX PANELS

As there will be a fair amount of force applied to the panel, you'll need to clamp or stick it down. We found that using a few rolled-up pieces of duct tape did the trick.



15 / APPLY ABRASIVE POLISH

You can use the same mild abrasive polish used in the manual guide by applying it to the polishing wheel. You'll need a fair amount of polish to lubricate the surface, as well as a little bit of WD40 to help prevent the wheel from heating up and melting.



16 / USE POLISHING ATTACHMENT

You don't need to apply too much pressure, as the tool is fairly heavy itself. Move it back and forth over the surface, stopping every ten minutes or so to buff the surface to check how your work is progressing.



17 / USE BUFFING ATTACHMENT

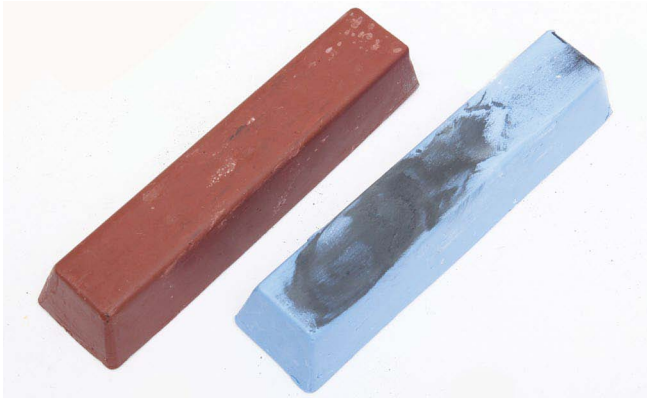
Once the scratches have gone, and you just need a final big buffing session to get a shine, switch to the buffing attachment. Again, use WD40 along with the paste to create a smooth polishing solution.



18 / USE A DRILL AND BUFFING ATTACHMENT

If you don't have a car-polishing tool then a power drill with polishing attachments work just as well. These attachments are large buffing wheels that fit onto standard drills and work edge-on.





19 / USE CUTTING COMPOUNDS

You can use a standard abrasive paste, but your best bet is to use cutting compounds specifically for the metal you're polishing. A starting compound will get rid of most of the surface blemishes, while a final compound creates a mirror finish.



20 / APPLY FIRST COMPOUND

To apply the compound, place the buffing attachment firmly against the compound stick and rotate it. Eventually the attachment material will turn brown as the compound clings to it.



21 / USE BUFFER ON SURFACE

Use a small amount of pressure and a moderate rotation speed, moving the attachment back and forth over the surface. Don't worry about any build-up at the edges – you can remove it later.



22 USE FINAL COMPOUND

Now switch to the final compound. You'll need to use a different buffing attachment and apply the final compound in the same way as you applied the starting compound, again applying mild pressure.



23 BUFF WITH MILD ABRASIVE POLISH

To clean up the panel and remove any compound residue, buff the panel with your mild abrasive polish. This process will even out the shine, ready for the lacquer, but make sure you wash the panel in detergent such as washing-up liquid first.



24 APPLY LACQUER

You can leave the panel in this state, but it's likely to oxidise over time and will need polishing again. To maintain the shine, apply a thin coat of standard lacquer. Apply two or three light coats, allow it to dry for 24 hours then buff it to a shine using car polish. **GPG**

CUSTOM PC

REALBENCH 2015

in association with **ASUS**

Give your PC a workout with our new benchmark suite, and see how your rig compares to other readers' machines

BENCHMARK YOUR PC

Download the benchmarks from www.asus.com/campaign/Realbench and, before you run them, disable any power-saving technologies in your BIOS that change your CPU clock speed, or the leaderboard won't record your overclock frequency properly. To post a score on the leaderboard, go to Save Upload File in the RealBench 2015 app's Results menu, and save your results in an RBR file. You need to select Offline Uploads on the leaderboard site, sign up for an Asus account and upload your file.

Gimp

We use Gimp to open and edit large images. Unlike our previous Gimp test, this one uses more than one CPU core, although it's still more sensitive to clock speed increases than to more CPU cores.

Handbrake H.264 video encoding

Our heavily multi-threaded Handbrake video encoding takes full advantage of

many CPU cores, pushing them to 100 per cent load.

LuxMark OpenCL

This GPU compute test is the only synthetic part of our suite, although the renderer is based on the real LuxRender physically based rendering software. As 3D rendering is a specific workload that not everyone will use, and because OpenCL support isn't standard in most software, this section is given just a quarter of the weighting of the other tests in the final score.

Heavy multi-tasking

Our new multi-tasking test plays a full-screen 1080p video, while running a Handbrake H.264 video encode.

Scores

RealBench 2015 breaks down the scores for each test, then gives you a total system score and a percentage reference score.

On an Intel system, the 100 per cent reference score comes from a stock-speed Core i7-4790K, with 16GB of Corsair 2,400MHz DDR3 memory, a 240GB OCZ 150 SSD, an Asus Maximus Gene VII motherboard and an Nvidia GeForce GTX 780 3GB graphics card.

On an AMD system, the 100 per cent reference score comes from a stock-speed A10-7850K APU, with 8GB of Corsair 2,133MHz DDR3 memory, a 256GB Plextor M5 Pro SSD and an Asus A88X-Pro motherboard, using the APU's integrated graphics. **GPG**

SHOUT OUTS!

There's no change at the top, with ian.parry3 (8Pack at Overclockers) ruling the top spot, with Luke@DinoPC in second – you can see the Dream PCs from these users in our Labs on p40. We've had some new entries too, from maliepaard.chris and viperz, with the former grabbing 20th place with a 3.62GHz Core i7-5820K – the secret is a 125MHz bus and a 29x multiplier.

CHROME WARNING

At the moment, Google's Chrome browser flags up the RealBench 2015 download as potentially harmful, and we're aware of this issue. The file is perfectly safe, however – please ignore this warning.

CUSTOM PC REALBENCH 2015 LEADERBOARD

	SYSTEM SCORE	REFERENCE	USERNAME	MOTHERBOARD	CPU	CPU CLOCK	MEMORY	PRIMARY GPU
1	233,375	203.9%	ian.parry3	Asus Rampage V Extreme	Intel Core i7-5960X	4.6GHz	32GB G.Skill 3200MHz	Nvidia GeForce GTX Titan X
2	219,415	191.7%	Luke@DinoPC	Asus Rampage V Extreme	Intel Core i7-5960X	4.6GHz	16GB Corsair 3276MHz	Nvidia GeForce GTX Titan X
3	201,446	176%	CustomPC	Asus Rampage V Extreme	Intel Core i7-5960X	4.3GHz	16GB Corsair 2666MHz	Nvidia GeForce GTX Titan X
4	197,964	173%	Carbonleg	Asus X99-E WS	Intel Core i7-5960X	Not reported	32GB Corsair 2400MHz	AMD Radeon R9 200 Series
5	189,230	165.3%	shadowrayne	Asus Rampage V Extreme	Intel Core i7-5960X	4.2GHz	32GB Corsair 2133MHz	Nvidia GeForce GTX 980
6	172,828	151%	mdottwo	Asus Rampage V Extreme	Intel Core i7-5820K	4.4GHz	16GB G.Skill 2766MHz	AMD Radeon R9 200 Series
7	166,078	145.1%	Chris_Waddle	Asus Rampage IV Black Edition	Intel Core i7-4930K	4.72GHz	16GB Corsair 2464MHz	Nvidia GeForce GTX Titan X
8	165,512	144.6%	Penfold	Asus X99-Deluxe	Intel Core i7-5820K	4.5GHz	32GB Corsair 2333MHz	AMD Radeon R9 200 Series
9	163,650	143%	shaunhanson	MSI X99S SLI Plus	Intel Core i7-5820K	Not reported	16GB Corsair 2133MHz	Nvidia GeForce GTX 980
10	163,400	142.7%	andy	MSI X99S Gaming 7	Intel Core i7-5820K	4.4GHz	16GB Corsair 2666MHz	Nvidia GeForce GTX 980
11	163,065	142.5%	viperz	Asus X99-Deluxe	Intel Core i7-5820K	4.48GHz	16GB Corsair 2400MHz	Nvidia GeForce GTX 970
12	155,685	136%	MAQ	Asus Rampage V Extreme	Intel Core i7-5930K	Not reported	32GB Corsair 2133MHz	Nvidia GeForce GTX 970
13	148,641	129.9%	claire.york83	Asus X99-S	Intel Core i7-5820K	4GHz	16GB G.Skill 2666MHz	AMD Radeon HD 7900 Series
14	148,066	129.4%	andrew_mcse	Asus Rampage IV Black Edition	Intel Core i7-4930K	4.3GHz	32GB G.Skill 1333MHz	AMD Radeon R9 200 Series
15	146,635	128.1%	hutch	Asus Rampage IV Extreme	Intel Core i7-4930K	4.5GHz	32GB Kingston 1333MHz	AMD Radeon R9 200 Series
16	146,123	127.7%	Samual	Asus Maximus VI Extreme	Intel Core i7-4790K	4.95GHz	16GB Team Group 2666MHz	Nvidia GeForce GTX 780
17	145,751	127.4%	sparrowhawks	Asus Rampage V Extreme	Intel Core i7-5820K	Not reported	16GB Kingston 2400MHz	Nvidia GeForce GTX 980
18	143,892	125.7%	robert_a_inglis	Asus Rampage V Extreme	Intel Core i7-5930K	Not reported	16GB Corsair 3000MHz	AMD Radeon HD 5800 Series
19	139,757	122.1%	dainye	Asus P9X79 Pro	Intel Core i7-3930K	4.6GHz	8GB Kingston 1600MHz	AMD Radeon HD 7900 Series
20	137,873	120.5%	maliepaard.chris	MSI X99S SLI Plus	Intel Core i7-5820K	3.62GHz	16GB Corsair 3000MHz	Nvidia GeForce GTX 660 Ti

Readers' Drives

Cosmos Cruizer

Inspired by car hotrods from the 1930s and 1940s, Brian 'Boddaker' Carter turned a Cooler Master Cosmos II chassis into a classic muscle car mod



CPC: What originally inspired you to build Cosmos Cruizer?

Brian: I've always been a hotrod enthusiast. I've been building and working on muscle cars since high school, learning how to do bodywork and mechanical repairs from my father who was a lead mechanic at United Airlines for 35 years. After my TRON scratch build, I decided to combine my love for hotrods and computer case modding, and build a hotrod-themed case mod. The Cosmos II chassis was the perfect case for this.



CPC: What does the name mean?

Brian: The mod was based on a Cooler Master Cosmos II, and it has a hotrod theme, inspired by the classic custom cruisers from the 1930s and 1940s.

CPC: What specs did you choose?

Brian: This PC is my personal gaming rig, so I wanted a decent system to run my favourite games. When I started, the Core i7-3960X and GTX 680 were the top-performing hardware – little did I know it would take me two and a half years to complete this project!

I'm currently upgrading to a pair of GTX 980 Ti cards, which will require me to rebuild the water-cooling manifold to fit the new blocks.

CPC: What other mods have you built?

Brian: I've built over 23 mods over the past ten years. At first, I built mods for myself and family members, but then I started doing commissioned builds for various companies to be displayed at events such as CES, Computex and PAX.

CPC: What difficulties did you come across?

Brian: For this project, the main difficulties concerned fitment issues with hardware – an incorrect measurement in the design can really cause headaches down the road. It didn't help when I decided to change hardware in the middle of the project either, especially when some parts were made specifically for that hardware. As a result, I had to remake numerous pieces to fit the new hardware – that's the downside of a project taking over two years to complete.

CPC: What materials did you use?

Brian: I used fibreglass to fabricate most of the panels on the case. Having never used it before, I did tonnes of research online to educate myself before attempting it. The top panel and the entire 'engine compartment' side panel is completely made out of fibreglass, along with the side scoops. The right side door was skinned in fibreglass as well.

The main focus of my hotrod concept was the open-air engine compartment design, where all the computer components are mounted. It was designed with specific hardware in mind, so all the parts fit perfectly, and it shows off the hardware and custom water

cooling. I designed a water channel manifold to accommodate two separate cooling loops (one for the CPU and motherboard blocks, and one for the graphics cards). Four Koolance Quick Disconnects couplings bring the coolant to and from the manifold through automotive steel-braided hose, while Primochill rigid tubing connects the manifold to each waterblock on the motherboard.

I gutted the entire Cosmos II case, and the new fibreglass engine compartment was fused together with the side bezel so that it could be mounted back onto the frame. I didn't like the location of the top aluminium handles on the Cosmos II, so I relocated them to the centre of the top panel to give the case a more streamlined look. The whole top panel was custom-fabricated with fibreglass, and incorporates the centre-mounted handles, as well as a centre mesh panel that provides an exhaust vent for the top 420mm radiator's fans.

A popular mod on custom hotrods of the 1930s and 1940s was to have suicide doors (where the direction in which the doors opened was reversed, so they opened from



/MEET THY MAKER

Name Brian Carter

Age 47

Location Northern California

Occupation Video and audio production

Main uses for PC Gaming

Likes Modding, muscle cars and mountain biking

Dislikes Annoying commercials and Brussels sprouts

SYSTEM SPECS

CPU Intel Core i7-3960X

Graphics card 2 x EVGA GeForce GTX 680 (soon to be 2 x GeForce GTX 980 Ti)

Memory 32GB Crucial DDR3

Case Cooler Master Cosmos II

Motherboard EVGA C79 Dark

Storage 2 x 256GB Crucial SSD

PSU 1,200W Cooler Master

Cooling EK waterblocks, radiators, reservoir and dual pump top; Primochill rigid tubing, fittings, and custom water channel distribution manifold; 140mm NZXT fans

SEE THE FULL
PROJECT LOG:

[http://tinyurl.com/
CosmosCruizer](http://tinyurl.com/CosmosCruizer)



the front), so I relocated the hinges of the right side door from the front to the rear, providing a better viewing of the internals. A large window was added to the door as well, and I also fabricated some custom side scoops to match the lines of the case.

The whole front of the case was also redesigned to accommodate a large chrome grille, as seen on many 1930s and 1940s vehicles. Above the grille, a new bezel was made to house a 7in LCD touch-screen, Lampton fan controller, USB 3 ports and, of course, an ignition key switch that powers on the PC.

Meanwhile, the original aluminium case feet, or rails, were chopped up and welded together to simulate exhaust headers. An extra pair of rails were ordered direct from Cooler Master to make this mod possible, as I needed four ends for each side. The power supply was then mounted vertically at the back of the case, and the ATX and PCI-E power cables were run through orange tubing to simulate spark plug wires. All the other power cables were run through aluminium brake lines, in keeping with the automotive theme – I don't enjoy sleeving cables, and will go to great lengths to find alternate methods of hiding my cables!

Other parts included a custom backlit SSD module, which I built to hold the two 256GB Crucial M4 SSDs, complete with chrome covers, and I employed polished 0.5in stainless steel tubing to connect all water-cooling components on the back.



I knew I also wanted flame-effect fan grilles incorporated in the build, but I didn't want run-of-the-mill, cookie-cutter flame-shaped grilles, so I devised my own 3D flame grilles for the lower radiator and back panel. I first designed the flames in Adobe Illustrator, and Primochill then laser-cut them out of 1/8in acrylic. I then painstakingly heat-bent each individual flame lick with a heat gun, and intertwined them so they weaved in and out of each other, creating the desired three-dimensional look.

They came out looking great, but nothing could have prepared me for how good they would end up looking after Bob Stewart had finished painting them!

The back panel was totally built from scratch as well, but with acrylic, since I wanted to have another 3D flame grille moulded into the panel itself. I also made a flip-up fuel door for the fill-port up top, which matched the polished aluminium bars coming down from the top panel. The same semi-circular design was mimicked on the bottom PSU fan grille and, since the motherboard I/O panel was nowhere near the case's rear panel

anymore, I made a new I/O panel with extension cables to connect it all up. Lastly, the PSU's power plug was relocated to the lower right corner to make it easier to access.

White leather upholstery was then used to cover the interior, and my mom helped by sewing the orange double-stitching on the floor and front piece. I also modded the Razer Deathstalker Ultimate keyboard to match the case, by removing the stock wrist pad, adding polished aluminium bars and painting it orange.

CPC: What tools and machinery did you use?

Brian: I used basic power and hand tools - a Dremel, jigsaw, files, a cordless drill and so on.

CPC: Are you happy with the end result, and is there anything you'd do differently if you built it again?

Brian: I'm very happy with how it turned out, but I would probably make the build process much simpler (and quicker!) if I had to do it again. I would also leave more room for cabling, so I wouldn't box myself in when it comes time to the wiring. **CPC**

BE A WINNER

To enter your machine for possible inclusion in Readers' Drives, your mod needs to be fully working and, ideally, finished based in the UK. Simply log on to www.bit-tech.net and head over to the forums. Once you're there, post a write-up of your mod, along with some pics, in the Project Logs forum. Make sure you read the relevant rules and advice sticky threads before you post. The best entrant each month will be featured here, where we'll print your photos of your project and also interview you about the build process. Fame isn't the only prize; you'll also get your hands on a fabulous selection of prizes – see the opposite page for details.

THANKS FROM BRIAN

I'd like to thank my sponsors: EVGA, Crucial, Cooler Master, EK, Lampton, Koolance, Razer and especially Primochill for all the laser cutting, rigid acrylic tubing and awesome fittings. I also want to give a super shout-out to BS Mods for the spectacular show-car quality paintjob, which really elevated this case far beyond my wildest dreams.

I'm dedicating this build to my mother and father, who both passed away last year. They worked their entire lives raising us three kids, and instilled their never-ending devotion and love for our family into me. My mother was creative, artistic, funny and always laughing and humming a song. My father was mechanically inclined, analytical, stern and responsible. I like to think I inherited something from each of them, and I hope I'm making them proud by embracing those traits in each case modding project I do. Love you, Mom & Dad!

Win all these prizes!

We've teamed up with some of the world's leading PC manufacturers and retailers to offer this great range of prizes to each lucky Readers' Drives winner. If your creation is featured in the magazine then you'll walk away with all of the prizes listed on this page, so get in your entries!

Corsair graphite Series 230T case and RM 550w Modular power supply

TOTAL VALUE £150 inc VAT / **MANUFACTURER** www.corsair.com

Corsair believes that a great PC starts with a great case. The Corsair Graphite Series 230T is a compact expression of this core philosophy. With stylish looks and a choice of three different colours, it packs in a remarkable number of features to provide builders with tonnes of room for expansion and amazing cooling potential. Like all Corsair cases, it's built using the finest materials and finished to the highest standards, so it will withstand several years of upgrades. Plus, to make sure it stand out from the crowd, the 230T features Corsair's new Air Series LED high-airflow fans, providing distinctive lighting with low-noise, high-airflow cooling.

Just as a quality case is essential to building a quality PC, a high-performance, a high-quality power supply is also a vital ingredient. The all new RM series has been built from the ground-up to deliver unmatched reliability alongside 80Plus Gold efficiency, and all with the absolute minimum of noise. It uses specially optimised quality parts to reduce sound at the component level, and it's completely silent below 40 per cent load, thanks to its Zero RPM fan mode. It's also fully modular, allowing for the maximum amount of flexibility during installation. With a Corsair Graphite 230T case and an RM 550W Modular power supply at the heart of your build, you'll have the foundations for a truly awesome gaming machine.



Mayhems coolant and dyes

VALUE £50 inc VAT /

MANUFACTURER www.mayhems.co.uk



Cooling performance is only one part of the equation when it comes to kitting out your rig with custom water-cooling gear. The other major bonus is that all those tubes and gleaming fittings just make your PC look damn sexy, and they look even better when they're pumped full of fancy coloured coolant. As such, we're particularly pleased to have the folks at Mayhems now on board with Readers' Drives; they're currently offering two 1-litre bottles of Mayhems' Pastel Ice White coolant, along with a selection of five dyes, so you can choose the colour that best complements your PC. Check out the blue coolant in our own mini PC mod on the cover of Issue 109 for an example of what's possible with some Mayhems coloured coolant.

Phobya Modding Kit

VALUE £50 inc VAT **MANUFACTURER** www.phobya.com, www.aqua-tuning.co.uk

The Phobya modding kit is designed with the modder in mind, offering great value for money and quality products. The kit includes Nano-G 12 Silent Waterproof 1,500rpm multi-option fans, which use an innovative fan-blade design. As standard, the fans include braided black cables to keep your case looking as neat as possible. The fans are also supplied with a special cable that lets you run the fan at 5V rather than 12V, reducing the noise emitted in order to help you to build a silent system.

The kit also includes the 60cm Phobya 3-pin Molex to 4x 3-pin Molex Y-cable. This pre-

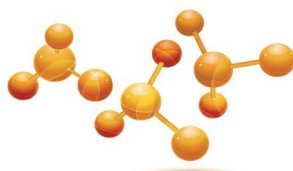
braided extension cable gives you extra routing options in your case, and it also enables you to run up to four fans from one compatible

motherboard header. Meanwhile, the Phobya SATA 3

cables included in the kit offer the same great quality braiding as the rest of the Phobya range, while also securing your connection with latched connectors.

As well as this, the kit includes the Phobya SlimGuide Controller, which gives you the option to vary the speed of other fans in your case, while the Phobya TwinLEDs let you shine a light on your mods.





Folding@Home

Join our folding team and help medical research

Folder of the month / We catch up with: Dickie

CPC: So who is Dickie?

Dickie: My name is Tim, and my long-standing nickname is Dickie. I've been folding on and off since 2006, and I work as a technical specialist at a local university.

CPC: Why did you start folding?

Dickie: I used to overclock all my machines' CPUs and GPUs, and FAH was always a good test to see how they coped.

CPC: What excites you most about folding?

Dickie: I like the idea of helping research and medical discoveries, but I also like to see how many points I can produce per day. I seem to have reached my maximum folding capacity at the moment.

CPC: How many machines do you have folding?

Dickie: Four, which are all in my office so it can get a little warm in summer. Two of them have Core i5 CPUs and two have Core i7s. All of them have a single GTX 970 each.



I don't fold with CPUs, as it creates a lot of heat and unwanted noise. The four GTX 970s produce over a million points per day between them, which is fantastic, and they use very little electricity and don't get very hot.

CPC: Do you intend to keep up your current production level?

Dickie: I hope to continue this level of folding, but most of the machines are earmarked to be installed into our workshops and classrooms so I may have to get some different ones.

CPC: Any tips for team members?

Dickie: Get a passkey – it makes a massive difference to the ppd count.

CPC: What do your friends and family think about your folding?

Dickie: My family aren't interested, and my friends think it's great but they also say I'm a bit obsessive about my daily points production.

CPC: What's your worst folding experience?

Dickie: The early days of folding,

when you had to faff about with the configuration of the folding machines, and some of the legacy hardware was unreliable.

CPC: And the best?

Dickie: Switching to the GTX 970s and getting an office with large windows.

CPC: Since we last caught up, how has folding changed?

Dickie: Hardware has evolved; modern GPUs are good value and use much less electricity than before. I think I started with a server CPU and an old Nvidia graphics card – my ppd was around 200. Now you don't need the most expensive cards, as they sometimes fail to produce many more points compared to the mid-range cards. I see that Custom PC has only just over 200 folders active, and over 9,000 inactive – it would be good to encourage more people to start folding again.

WHAT IS FOLDING?

Folding@home uses the spare processing cycles from your PC's CPU and graphics cards for medical research. You can download the client from <http://folding.stanford.edu> and our team's ID is 35947. Once you pass a significant milestone, you'll get your name in the mag. You can also discuss folding with us and other readers on the www.bit-tech.net forums.

STATS

Team rank 38

World rank 1649

Score 64,397,482

Work units 6,510

Daily points average 1,039,598

TOP FOLDERS: This month's shout-outs go to Andy_J, bigrew, PRJKITCH and BeezaBob. If you fold under any of these names, email folding@custompcmag.org.uk

MILESTONES THIS MONTH

USERNAME	POINTS MILESTONE	USERNAME	POINTS MILESTONE	USERNAME	POINTS MILESTONE	USERNAME	POINTS MILESTONE
LiamAsman	20000	Bob_D	800000	matgsi	7000000	Maglor	30000000
QuasarGreg	20000	LboroSlider	800000	RabidMongoose	7000000	BeezaBob	40000000
tallandgentle33uk	40000	MikePreston	900000	Tommye123	7000000	Dickie	40000000
ZeroExistancE	40000	wew	900000	Jon_Simmo	8000000	8Core	70000000
whiskeyecho	50000	Bobthetoolnut	1000000	SP1	9000000	Wilding2004	70000000
Alee4177	60000	elpaulio	1000000	adbygrave	10000000	mmorr	80000000
bradbooth	60000	Lethaertes	1000000	billssteam	10000000	Roveel	80000000
bimbap	70000	RaistlinRTCW	1000000	gupsterg	10000000	HHComputers	300000000
BenScoobert	80000	bigrew	2000000	madmatt1980	10000000	Slavcho	300000000
callumtho	90000	Igniseus	2000000	Simlec	10000000	piers_newbold	500000000
Jaffo	100000	Clotten	3000000	Andy_J	20000000	Scorpuk	600000000
Philhasnoidea whathe\'\'sdoing	100000	ghodula	3000000	BillyTheCat	20000000		
tastyradiskull	100000	PRJKITCH	3000000				
CZslamz	200000	BondyBoy	4000000				
TimmyH	200000	techknowledgey	4000000				
Chris0rz	300000	Trunkey	4000000				
jamiesp17	300000	kiiight	5000000				
davm64	500000	Liam266	6000000				
The_FFrey	500000	slowpurple	6000000				
bastardo_bill	600000	ZeDestructor	6000000				
Zaratoustra	600000	Allan_Smith	7000000				
Quozzbat	700000	Brentwood- Computers.com	7000000				
BigD-lite	800000	MarkVarley	7000000				

THE NEXT OVERTAKE

WORLD RANK	TEAM NAME	POINTS	DAILY POINTS AVERAGE	TIME UNTIL OVERTAKE
2	[H]ardOCP	50,388,171,829	7,390,473	12.7 years
5	www. overclockers.com	22,448,284,128	9,909,781	3.1 years
7	TSCI Russia	18,044,686,514	11,072,635	8.7 months
8	Custom PC & bit-tech	17,134,757,843	14,547,029	0
18	LinusTechTips_ Team	6,071,015,093	18,092,556	8.5 years

TOP 20 OVERALL

RANK	USERNAME	POINTS	WORK UNITS
1	Nelio	2,369,554,483	122,884
2	DocJonz	1,193,942,502	175,161
3	coolamasta	743,686,896	168,316
4	Scorpuk	605,345,225	15,851
5	StreetSam	563,859,457	90,073
6	piers_newbold	517,139,935	41,208
7	Dave_Goodchild	464,332,483	119,147
8	johnim	385,732,627	80,553
9	PC_Rich	376,132,482	75,360
10	HHComputers	320,417,219	17,527
11	Slavcho	311,907,416	33,432
12	Lordsoth	272,091,880	93,188
13	The_M2B	263,108,913	56,676
14	phoenicis	250,044,587	95,660
15	Wallace	212,477,027	6,204
16	zz9pzza	211,014,628	15,794
17	TheFlipside	185,485,666	21,142
18	Desertbaker	167,191,301	15,263
19	Ben_Lamb	166,053,146	2,891
20	Laguna2012	164,784,691	17,601

TOP 20 PRODUCERS

RANK	USERNAME	DAILY POINTS AVERAGE	OVERALL SCORE
1	DocJonz	1,794,436	1,193,942,502
2	HHComputers	1,563,386	320,417,219
3	piers_newbold	1,165,900	517,139,935
4	PC_Rich	795,463	376,132,482
5	Scorpuk	773,299	605,345,225
6	Slavcho	584,578	311,907,416
7	johnim	568,864	385,732,627
8	Wilding2004	514,016	77,892,976
9	coolamasta	427,628	743,686,896
10	Nelio	423,459	2,369,554,483
11	apeman556	410,144	120,979,190
12	Desertbaker	394,125	167,191,301
13	The_M2B	394,114	263,108,913
14	Lordsoth	384,600	272,091,880
15	Laguna2012	371,034	164,784,691
16	Roveel	345,698	88,664,365
17	Maglor	244,754	33,708,920
18	Dickie	234,692	41,735,661
19	Andy_J	193,651	22,260,601
20	BeezaBob	187,664	42,617,656



JAMES GORBOLD / HARDWARE ACCELERATED

SKYLAKE'S 134% SPEED BOOST

A Skylake upgrade might not net you much more CPU performance, but it's a real boon for SSD speed, argues James Gorbold

One of the joys of working at Scan is getting to test (also known as 'play with') samples of new products, often months before their general release. This month, two major new products have been released – Microsoft Windows 10 and the Intel Skylake platform.

Windows 10 is a massive improvement compared with Windows 8, ditching the horrific Metro interface in favour of a redesigned Start menu, coupled with other notable improvements such as Task View, multiple desktops and the ability to snap applications into the corner of your screen. However, the biggest potential improvement of Windows 10 – DirectX12 – has yet to prove itself; apart from a few tech demos such as Square Enix's *The Witch*, no games use the new API yet.

On the other hand, upgrading to Skylake brings some immediate benefits. Not from the CPU itself, which will only net you a 5-13 per cent performance gain according to my own testing, but because Skylake unlocks the full potential of M.2 PCI-E SSDs. Previously, the M.2 slots on Z97 motherboards were only connected to the chipset via two PCI-E 2 lanes, which with a combined theoretical bandwidth of 1GB/sec, is much slower than a PCI-E SSD. For instance, when I benchmarked the highly popular Samsung SM951 PCI-E SSD on a Z97 motherboard, it was limited to a read speed of 732MB/sec, despite being rated by Samsung as capable of reading at up to 2,150MB/sec.

In contrast, the new Z170 chipset has many more PCI-E lanes than Z97 and is connected to the CPU via the much faster DMI 3 bus. The chipset has several other benefits, such as four more

USB 3 ports, but by far the biggest beneficiaries are PCI-E SSDs, as Z170 motherboards can support up to four M.2 slots, each connected via four PCI-E 3 lanes. Each M.2 slot therefore has a theoretical bandwidth of 3.94GB/sec, a nearly fourfold increase over the M.2 slots on Z97 motherboards.

Using the same Samsung SM951 PCI-E SSD, this change translated into a staggering 134 per cent performance increase from 732MB/sec on Z97 to 1,715MB/sec on Z170 in my tests. This result is all the more exciting when you realise that a PCI-E SSD

such as the Samsung SM951 only costs around £40 more than a SATA SSD with the same capacity, which will bumble along at a mere 540MB/sec.

The Skylake platform isn't without faults though – despite the increase in USB ports, they're still 3.0 ports, rather than the newer and far faster 3.1 variety. Of course, most motherboards over £120 will have USB 3.1

controllers added, but Z170 should have had USB 3.1. In addition, there's a new Gen 9 GPU, with support for DirectX 12 and OpenCL 2. However, it's still arguably a waste of silicon, as almost nobody uses the integrated GPU on a K edition CPU.

Still, on balance, Skylake is a worthy step forward from Haswell, especially as Z170 enables you to unlock the full potential of M.2 PCI-E SSDs. I just hope we'll start seeing M.2 SSDs with a capacity greater than 512MB soon; with the ever-growing size of games, this capacity is now feeling quite limited. As an aside, Skylake is also good news for anyone considering upgrading to the X99 platform, as the larger supply of DDR4 memory should drive down prices. **GPC**

The M.2 slots on Z97 motherboards were only connected to the chipset via two PCI-E 2 lanes

James Gorbold has been building, tweaking and overclocking PCs ever since the 1980s. He now helps Scan Computers to develop new systems.

msi

MSI recommends Windows.



GT72 Dominator Pro



Intel® Core™ i7 5950HQ / 5700HQ Processor | Windows 8.1 |
NVIDIA GTX 980M / 970M Graphics | SUPER RAID 3 | COOLER BOOST 3 |
SHIFT | TRUE COLOR TECHNOLOGY | NAHIMIC AUDIO ENHANCER |
KILLER DOUBLE SHOT PRO | STEELSERIES KEYBOARD

Intel Inside®. Extraordinary Performance Outside.



WHERE TO BUY

SCAN Computers / www.scan.co.uk / 0871 472 4747

Box Ltd / www.box.co.uk / 0121 202 0030

Ebuyer / www.Ebuyer.co.uk / 0371 521 3300

CCL Computers / www.cclonline.co.uk / 0127 447 1201

Overclockers UK / www.overclockers.co.uk / 0178 244 4455

Currys PC World / www.pcworld.co.uk / 0344 561 0000

Very / www.very.co.uk / 0844 822 2321

Laptops Direct / www.laptopsdirect.co.uk / 0871 971 0005

Dabs / www.dabs.co.uk / 0870 429 3825

NO. 1 IN GAMING

Intel, the Intel Logo, Intel Inside, Intel Core, and Core Inside are trademarks of Intel Corporation in the U.S. and/or other countries.

GAMING.MSI.COM

www.scan.co.uk

t: 01204 47 47 47

SCAN COMPUTERS

What



Dream



TBC...

Scan Platinum Partners



Get Metal Gear Solid V: The Phantom Pain FREE* with select GeForce® GTX™ GPUs

For a limited time, get the latest mega hit from Kojima Productions, METAL GEAR SOLID V: THE PHANTOM PAIN with a qualifying purchase of GeForce® GTX™ 980 Ti, 980, 970, or 960 GPU or a 980/970M notebook.



Corsair STRAFE Mechanical Gaming Keyboard

STRAFE will enable your skills to reach their full potential. Brilliant backlighting is enhanced with virtually unlimited dynamic lighting configurations - craft your own, or choose from six unique presets.



Intel® Core™ i7 Processor Extreme Edition

Want maximum performance in your favourite content creation applications and games? Then the new Intel Core i7 processors, based on the Haswell architecture, were made for you. This new range of LGA2011 socket processors feature more cores, more cache and more memory bandwidth than ever before.



Don't buy hardware without **Scansure** protection. 28 day installation damage insurance www.scan.co.uk/scansure.



Scan Finance. Buy now, pay 10% deposit* and spread the cost over 36 or 48 months when you spend £300 (inc vat) or more.

Prices correct at time of print. Classic credit options (36 or 48 months). Customers will initially only have to pay a 10% deposit, with the original loan amount payable over 36 or 48 months.
*Example: £1,000.00 Deposit: £100.00 Amount of loan: £900.00 Total charge for credit: £276.12 Total payable: £1276.12 Total 36 Monthly instalments of: £32.67 APR: 19.9%. Terms and Conditions Apply.